CARDIOVASCULAR DISEASE RISK AND THE ASSOCIATION WITH ACCULTURATION IN WEST AFRICAN IMMIGRANTS IN THE UNITED STATES.

by

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ABSTRACT

Background: Cardiovascular disease (CVD) is a leading cause of morbidity and mortality in the United States (US). Despite substantial reduction in CVD events of Americans, many ethnic minorities experience striking CVD disparities, with insufficient research to explain these disparities. Limited research conducted in West African Immigrants (WAI), specifically Ghanaian and Nigerian immigrants residing in other high-income countries has revealed a high prevalence of CVD risk factors. However, no epidemiological studies have explored CVD risk and the association with behavioral, social, economic and cultural factors in African immigrants in the US.

Design and Methods: : Cross-sectional study epidemiological of West African immigrants (Ghanaian and Nigerian-born) aged 35–74 years residing in the Baltimore, Washington-D.C metropolitan area. A full fasting lipid-profile, glucose concentrations, blood pressure and anthropometric measured were obtained and a modified World Health Organization questionnaire with items assessing social support, CVD knowledge and acculturation was administered to participants.

Findings: The mean age of the 253 participants was 49.5±9.2 years and 58% were female. Males were more likely to be employed than females (90% vs. 72%; p=0.001). Only 52% of participants had health insurance. The majority (54%) had ≥3 CVD risk factors and 28% had PARS10 ≥7.5%. Smoking was the least prevalent (<1%) and overweight/obesity the most prevalent (88%) risk factor. Although females (64%) were more likely to be treated for hypertension than males (36%), there was no difference in hypertension control by sex. Diabetes was identified in 16% of the participants. Mean

total cholesterol (TC) was 180.9±33.9mg/dL and 32% had TC level ≥200mg/dL. Also, 44% were found to be physically inactive. In females, employment [0.18 AOR, 95%CI: 0.075-0.44)] and health insurance [0.35 AOR, 95%CI 0.14-0.87)] were associated with a PARS10 ≥7.5%. In males, higher social support was associated with a 0.92 (95%CI: 0.84-0.98) odds of having ≥3 CVD risk factors.

Conclusions: The healthy immigrant effect may not hold for this current generation of African immigrants. Larger studies are need to confirm the relationships between predisposing, reinforcing and enabling factors and CVD risk as well as the association between acculturation and CVD risk identified in this study.

Advisor: Dr. Cheryl Dennison Himmelfarb, PhD, ANP, RN, FAAN

DEDICATIONS

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CHAPTER ONE: INTRODUCTION

Cardiovascular disease (CVD) remains the leading cause of death in the United States with 1 in 3 deaths attributable to CVD and the prevalence of CVD risk factors and poor health behaviors remains high.[1] The Framingham Heart Study[2,3] and INTERHEART Study[4] have demonstrated that major CVD risk factors and poor health behaviors such as smoking, obesity, hypertension (HTN), hyperlipidemia, physical inactivity, and diabetes mellitus synergistically increase the risk for CVD events. In Sub- Saharan Africa (SSA), CVD is a growing cause of death and disability resulting from the "epidemiological transition"; which is characterized as shifts in disease patterns and mortality patterns from infectious diseases to non-communicable disease as major causes of morbidity and mortality.[5] In SSA, more than half of the CVD deaths occur among persons between 30 and 69 years of age, a range which is 10 years younger than the equivalent group in Europe and North America. [6,7]

The influx of African immigrants to the US in the last two decades has been unparalleled. The number of African immigrants to the U.S. grew 40-fold between 1960 and 2007, from 35,555 to 1.4 million, including 36% from West Africa.[8] Together, Ghanaian and Nigerian immigrants make up more than 30% of West African Immigrants (WAI) in the US.[8] Despite the growing presence of this population, little is known about the prevalence of CVD, CVD risk factors and health behaviors and overall risk for CVD. Research from Hispanic and Asian immigrants cannot be generalized to all immigrants considering the diversity of economic, social and political backgrounds of immigrants. The "healthy immigrant effect"[9,10]which suggests that new immigrants are healthier than their host counterparts is a well-accepted phenomenon. However, the health of

immigrants rapidly declines or improves with increasing years of residence in developed countries through the loss of culture-specific health protective effects or adoption of health behaviors of the host society.[10-12] Changes in socio-economic conditions, food supply, health systems and policies, and cultural traditions may be reasons for deteriorating or improving health in immigrants.

With regards to cultural changes, acculturation has been described as the resulting phenomenon when groups of individuals with different cultures come into continuous first-hand contact, and subsequently changes the cultural patterns of either or both groups.[13] Again, the literature on acculturation and its association with health in Hispanic and Asian immigrants is ample, with very little research conducted in African immigrants. This research gap can be attributed to the fact that "Blacks" in the US are often considered a homogeneous group in research [14]; ignoring the cultural and socioeconomic differences between recent African immigrants and US-born African-Americans. Hence, we examined the association between acculturation and CVD risk, utilizing a validated and dimensional measure of acculturation as well as the proxy measure of length of residence in the US.

Identifying predisposing (i.e. CVD knowledge, employment status), reinforcing (i.e. social support) and enabling (i.e. health insurance status) factors is crucial in developing and implementing future CV health interventions in this group. For instance, low socio-economic status measured as income and educational status predicts CVD independently of traditional risk factors included in the Framingham risk score[15-18] and lack of health insurance is associated with increased rates of stroke and death and with less awareness and control of CVD risk factors.[19] However, these determinants have yet to

be explored in African immigrants in the US. This study examined how these determinants influence CVD risk in African immigrants which will inform primordial, primary and secondary prevention efforts as well as health policies that directly impact this population.

BACKGROUND

CVD Risk Factors among West Africans residing in Africa

Since data on CVD risk factors on African immigrants is limited, evidence of CVD risk factor status among Africans residing in Africa was reviewed to establish the context for the study.

Hypertension in West Africa

In West Africa, hypertension (HTN) is the most common non-communicable disease and it has emerged as the most important risk factor for CVD, affecting about 10 to 30% of the population. [5,6] In the absence of adequate control measures, the prevalence of HTN in Nigeria ranges from 21%[20]to 37%[21] and in Ghana it ranges from 19%[22] to 55%[23]. In Accra, the capital city of Ghana, hypertension moved from the fourth to the second leading cause of outpatient morbidity in 2007[7]. Until recently HTN was thought to be rare in rural West Africa.[24] However recent studies have estimated a growing HTN prevalence of 25%(crude)[25] to 30%(crude)[26] in rural Ghana and 20%(crude)[20] to 32.8%(crude) in rural and semi-urban Nigeria.[27]

The detection, treatment and control of HTN are suboptimal due to scare resources and suboptimal health care provision.[28,29] Under- diagnosis of HTN may contribute to poor outcomes as an investigation into 79 cases of sudden cardiac deaths in Ile-Ife Nigeria revealed that hypertensive heart disease was the cause of death in 66 cases (83.5%), of which only 20 (30.3%) were previously diagnosed.[8] Cappuccio and colleagues[30] conducted a focus assessment of the prevalence, detection, management and control of HTN in rural and urban Ashanti Region, Ghana(n=1013) and found a worrisome overall prevalence of 28.7%(crude), detection rate of 22% and rates of treatment and control were

11.3% and 2.8%, respectively. A recent similar study conducted in rural Nigeria (n=2678) found a HTN prevalence of 19.3% (age-standardized), detection rate of 3% and control and treatment rates of 2% and 3% respectively.[31] Together these studies highlight the growing prevalence of HTN and low detection, treatment and control rates, which are partly explained by poor access to health and unaffordability of medications and travel to health care centers.

Dietary behaviors to manage HTN in West Africa are also suboptimal. Epidemiological studies have shown that Ghanaians and Nigerians do not engage in regular physical activity[32,33]and consume unhealthy quantities of dietary salt[34], although clinical trials have established that physical activity[35] and reduction of dietary sodium intake[36] lower blood pressure and reduce the risk of CVD. For instance, a rural adult population in Ghana was found to consume about 12.5 g of (pure) salt per day[22] which is in excess of the current international recommendations of <5g salt per day[37]. Since people of African descent have been identified as having a much higher risk of target organ damage compared to Caucasians for a given blood pressure in the US[38,39]and CVD in Africans occurs at an earlier age compared to their counterparts in high income countries[40], addressing hypertension in WAI may be one of the most important strategies for preventing target organ damage and delaying the onset of CVD in WAI.

Overweight/Obesity in West Africa

Once considered a problem of the wealthy nations, the World Health Organization (WHO) estimates that overweight and obesity has increased dramatically in Sub Saharan Africa (SSA) and is associated with increased morbidity and mortality.[41] In an epidemiological study (n=1471), adjusting for age and education, the odds ratios (OR) for

overweight/obesity were 19.1 for Dutch- Ghanaian men and 3.1 for urban Ghanaian men compared with rural Ghanaian men.[42]

Among women, the OR for overweight/obesity were 11.4 for Dutch-Ghanaians and 3.84 for urban Ghanaians compared with rural Ghanaians. [42] Cultural perceptions may also compound this issue as in many in West African societies, there is a positive social perception about overweight and obesity, as they are taken to represent signs of 'good living' and are associated with wealth, feminine beauty and freedom from HIV/AIDS.[43,44] This perception could reinforce unhealthy lifestyles that lead to overweight and obesity in WAI. In Ghana, Amoah[45] observed that wealthy participants with a high level of education (tertiary education) had the highest prevalence of obesity (18.8%) compared to those with lower literacy(12.5-13.8%) and the prevalence of obesity in females was four times (20.2% vs. 4.6%) higher than in males. In a continent plagued with food insecurities and undernutrition, overnutrition is on the increase and is reflected in the rapidly increasing rates of overweight/obesity and associated complications. These results suggest WAI may be a higher risk for overweight and obesity which may subsequently increase their risk for CVD upon migration to the US.

Dietary Behaviors in West Africans

During the last century, there have been wide-reaching changes in nutritional status, dietary behaviors and disease patterns globally, with the West African region being no exception. There is a remarkable shortage of published data on the dietary behaviors of West Africans. However, the nutrition transition is said to be rapidly accelerating from the 'receding famine stage' (characterized by increased fruit, vegetable, protein consumption and decreased carbohydrate intake) to the nutrition– related non-

communicable disease stage (characterized by diet high in fat, refined carbohydrates, sugar and cholesterol and low in fiber)[46] ,which has resulted in a simultaneous prevalence of underweight and overweight/obesity.[47]In an analysis of the nutrition transition and mortality rates in 40 Sub-Saharan African countries, Abrahams and colleagues[48] found that Ghana had the second highest score (South Africa having the highest) which was translated as Ghana having relatively low levels of infant mortality rate and underweight, and relatively high levels overweight/obesity as well as energy and fat intakes supportive of the classic signs of a population in the nutrition-related non-communicable disease phase of the nutrition transition.

Diabetes Prevalence in West Africa

Diabetes is undoubtedly rising globally[49] and West Africa has not been spared from this rising tide of diabetes prevalence. Epidemiological data on the prevalence of diabetes is scanty although the available data foreshadow very worrisome trends. Type 2 diabetes is the most common form in SSA and is becoming more prevalent due to increasing rates of obesity, physical inactivity and urbanization.[50] The International Diabetes Federation reports that 3.2% or 12.1 million Africans had diabetes in 2010 and there were considerable difference among different communities in sub-Saharan Africa. [49]Specifically in West Africa, a meta-analysis showed that the diabetes prevalence in 1998 increased among urban Ghanaians (6.3%) and Nigerians (6.8%) in West Africa compared to historical data indicating extremely low prevalence (0.2% in 1963, Ghana; 1.7% in 1985, Nigeria).[51] The most recent epidemiological study on the prevalence of diabetes in Ghana (n=4733) was conducted a decade ago by Amoah and colleagues[52] in Accra and found adult diabetes prevalence of 6.4% (Adjusted to new world population)

and impaired glucose tolerance prevalence of 10.7% (Adjusted to new world population). In Nigeria, an age standardized diabetes prevalence of 7.9 % (n=502) has been reported with 40% unaware of their condition and 83% of patients asymptomatic.[53] Although the limited estimates of diabetes prevalence are lower than the 11.3% diabetes prevalence in adults ≥ 20 years reported in the US[54], these studies suggest that the burden of diabetes is quickly rising. Also, urban residence is associated with a 2 to 5 times higher risk or impaired glucose tolerance in Africa[55-57], suggesting that immigrants of African descent may present with even higher risk of diabetes as a result of migration from rural and urban settings to developed nations.

Physical Activity Levels in West Africa

Physical inactivity increases the risk of overweight/obesity, coronary heart disease, stroke and type 2 diabetes and may very well be one of the most important modifiable risk factors for CVD.[58,59]Like many developing regions, epidemiological data on physical activity levels in West Africa is limited. A 51-cross country survey of physical inactivity conducted by the World Health Organization[60] estimated that 7.9% (95% CI 5.9-9.8) of males and 15.1% (95% CI 12.7-17.5) of females were physically inactive in Ghana (n=3,362) and Ghana had the 4th lowest physical inactivity levels in comparison to 17 other African countries using the using the International Physical Activity Questionnaire(IPAQ). A similar study conducted in young adults residing in Nigeria (n=1006) using the IPAQ determined that 41% of the population were physically inactive.[61] Another cross sectional survey(n=532) of preretirement and retired civil servants in North-Western Nigeria demonstrated that only 38.3 % of the pre-retired and 22.1% of the retirees participated in moderate physical activity with males, rural dwellers

and persons of lower SES reporting higher levels of moderate physical activity.[62] The low levels of physical activity in these two countries and particularly urban areas can be partly explained by environmental and infrastructural barriers such as limited walkways and parks in cities for joggers and for running and lack of recreational and sporting facilities to encourage regular physical activity. [45]These results suggest that physical activity levels in persons residing in these two countries may be suboptimal and persons with sedentary lifestyle who migrate to developed countries continue these behaviors post migration.

CVD Risk Factors in West Africans residing in high-come countries

Internationally, in-migration and out-migration during the past decades has generated an unprecedented amount of cultural diversity in many developed countries. Although West African Immigrants have contributed to the diversity of high-income countries research is limited on the cardiovascular disease risk profile of WAI in comparison to other immigrant groups such as Hispanics and Asians. In the US, it is difficult to determine the CVD risk of WAI from population-based studies because WAI, African-Americans, and African-Carribeans are studied as a homogenous group defined as "Black". Most studies on the WAI population however, are limited to the Netherlands. In the US, Hyman and colleague's[63100] comparative study of the prevalence of hypertension in first generation African immigrants and African-Americans published in 2010, is one of the few published studies that addresses hypertension in African immigrants, which showed a lower prevalence of hypertension in African immigrants as compared to African-Americans. However, the small sample size of 87 African immigrants and Africa-Americans (n=95) and non-representative sample of registered pharmacists and nurses, may limit the generalizability of these findings to the current

population of WAI. Another US study by Borrell and colleagues[64] explored the Black/White disparity in self-reported hypertension accounting for nativity status and observed that foreign-born blacks(countries of origin not specified) with more than 10 years of residence in the U.S.,had 58% (OR 1.58, 95% CI 1.27–1.96) greater odds of reporting hypertension than their White counterparts. It is unclear how many African immigrants were considered foreign-born and if Ghanaian and Nigerian immigrants were included in their sample which limits the generalizability of their findings to current WAI.

In the Netherlands, Beune and colleagues compared the explanatory models of hypertension in native Dutch, first generation Ghanaian and Surinamese hypertensives in a qualitative study and reported that Ghanaian immigrants(n=16) stated that fufu (a Western-African staple food made up of starchy root vegetables) caused hypertension and altered their drug dosages for fear of addiction and inability to afford their medications.[65]All the participants in this study had difficulty explaining hypertension, with majority (88%) of Ghanaian immigrants perceiving stress as the principal cause of hypertension. Moreover, all the Ghanaian immigrants were particularly likely to report noticing symptoms and trusted their bodies to alert them to fluctuations in their BP, keep their hypertension status a secret from their families and report discontinuing their medications when visiting or returning to Ghana. It is unknown whether these explanatory models of hypertension are similar to those of WAI residing in the US and further research in this population in the US will expand our understanding of the prevalence of hypertension and the impact of socio-cultural factors on their perception of hypertension management.

Agyemang conducted a pilot CVD risk assessment of Ghanaian immigrants in the Netherlands (n=221) aged 18-60 years in the Netherlands and observed high prevalence of overweight/obesity (90%), physical inactivity (56%), HTN (52%), type 2 diabetes (6%) and low prevalence of smoking (1%).[66] In the aforementioned study, the prevalence of HTN among the Ghanaian migrants far exceeded those reported among African Surinamese in the Netherlands[67] which suggests that the prevalence of CVD risk factors may differ among ethnic groups of African descent. While Agyemang and Beune's study findings have implications for WAI residing in the US, no similar studies of WAI have been conducted.

Acculturation

In 1936, Redfield , Linton and Herskovits[13]s[18] provided the most widely accepted definition of acculturation as the "resulting phenomenon when groups of individuals with different cultures come into continuous first-hand contact, and subsequent changes in the cultural patterns of either or both groups" and under this definition acculturation is to be distinct from assimilation. This phenomenon has been studied widely in persons residing in countries other than their native countries including immigrants, international students, and refugees.[68] Although the terms multiculturalism, biculturalism, integration, and assimilation have either been used interchangeably with acculturation, acculturation is considered the most preferable for the purposes of this study because it acknowledges the reciprocity of influences cultural groups may have on each other. The conceptualization of acculturation has evolved over the decades and remains heavily debated in the literature to date. Originally conceptualized as a unidimensional process with retention of the heritage culture and acquisition of the host culture at opposing ends of the

spectrum[69],cultural psychologists have recognized that the acquisition of beliefs, values and practices of the host cultural does not automatically result in the absolute loss of the heritage culture. This paradigm shift has resulted in the reconceptualization of acculturation by Berry[68] as an orthogonal concept with host and ethnic culture affiliations existing independently rather than linearly. While Redfield[13] initially conceptualized a group-level phenomenon, it was later acknowledged that acculturation also occurred on the individual level as vast differences in acculturation may exist even in people who reside the same acculturative area.[70] Two pathways have been hypothesized as ways individuals and groups acculturate[71] and include (1) the degree to which people wish to maintain their heritage cultures and identities and (2) the degree to which people wish to have contact with those who are outside their group and participate with them in the daily life of the larger society which results in the adoption of 4 different acculturation strategies including *Integrationist, Assimilationist, Traditionalist* and *Marginalist*.

Knowledge on the association between acculturation and CVD risk in immigrants is limited to Hispanics and Asians residing in the US. However, there are valuable lessons to be learned from research in these immigrants groups and exemplars of the relationship between acculturation and health behaviors, CVD risk factors and CVD events are detailed in ***Table 1.1*** These exemplary studies highlighted in ***Table 1.1*** suggest that the relationships between acculturation and health behaviors and risk factors are significant, complex and not always consistent. For instance, within the same ethnic immigration population of Mexican-Americans, the results are conflicting with acculturation being associated with both positive and negative health behaviors as illustrated in ***Table 1.1.*** One possible explanation for these conflicting findings is that

acculturation is a multidimensional concept and its measurement will vary across studies, populations and age groups. Furthermore, the relationship of acculturation on health outcomes including mortality, morbidity and healthcare utilization may be moderated or mediated by other factors. Common moderators/mediators proposed in the literature include age, genetics and socio- economic status. For instance, in a study of the relationship between acculturation and health behaviors in 573 Latinas(46-92 years) residing in Los Angeles, California, acculturation was negatively associated with a summative health score based on tobacco and alcohol use, sleeping and physical activity while the relationship was stronger women 66 yrs. or younger), which is suggestive of interaction by age. [72]

Outcome Variable	Study Population	General Results
Diet and Exercise	Mexican-Americans, California	Increased parental acculturation had association with dietary fat intake and lack of exercise in Mexican-American children [73]
Smoking	Hispanics, California	Acculturation had + correlation with frequency of smoking [74]
	Mexican Americans	Acculturation had+ association with smoking with stronger effect in women. [75]
Exercise and BMI	Mexican-American, Texas	Acculturation had + association with exercise habits, SES and – association with BMI[76]
CVD risk factors, Health behaviors	Overweight Mexican American women(18–65 yrs.), Texas	Increased acculturation associated with poor exercise habits. Exercise habits mediated – relationship between acculturation and BP.[77]
Obesity and Diabetes	Mexican-Americans, Texas	Increased acculturation associated with reduced prevalence of obesity and diabetes in both sexes [78]
Diabetes, Diabetic Complications, and Health Care Access	Hispanics, (Hispanic Health and Nutrition Examination Survey [HHANES]'99-'02)	Low acculturation related to higher prevalence of diabetes its and neuropathic complications and no routine health care. [79]
Hypertension	Mexican Americans (HHANES '82-84)	Middle aged men with median acculturation had higher HTN prevalence than those with lower or higher acculturation scores.[80]
Hypertension	Asian Canadian immigrants	Self-reported hypertension more prevalent with longer period of immigration.[81]
Coronary artery disease (CAD), carotid intima media thickness, CAD risk factors, Type 2 diabetes(T2D)	South Asian Immigrants	Higher acculturation positively associated with CAD, T2D and carotid artery intima media thickness.[82]

TABLE 1.1. Exemplars of the association between acculturation and CVD risk factors and poor health behaviors

SIGNIFICANCE OF THE STUDY

An extensive review of the literature on CVD risk factors and health behaviors in WAI residing in the US has revealed significant gaps in epidemiological research in comparison to other immigrant groups. An assessment of the global risk of CVD defined as the probability of the development of CVD based on summation of the major risk factors[2,83] is clinically relevant for the following 3 purposes (1) identification of high-risk persons (2) motivation of individuals to adhere to risk-reduction therapies and (3) modification of intensity of risk-reduction efforts based on the total risk estimate.[131] Effective primary prevention in WAI requires an assessment of risk to characterize the population and categorize individuals for subsequent development and testing of tailored risk reduction intervention.

This study provided a unique opportunity to estimate the CVD risk of WAI in the US in order to guide the development and implementation of primordial and primary prevention strategies. Furthermore, in order to develop effective health policy and successful clinical and public health strategies, more evidence is needed on CVD risk and the underlying contributory factors in WAI in whom data are clearly lacking. Data from this study will help identify relevant factors including personal, socio-demographic and cultural factors that are associated with CVD risk and assist in the design and implementation of future longitudinal studies to determine the evolution of CVD risk during migration in WAI.

SPECIFIC AIMS

The overall purpose of this study was to contribute to the understanding of the CVD risk and the intricate relationships between behavioral, environmental, social and cultural factors among WAIs residing in the US. The specific aims of the study were as follows:

1) To examine the prevalence of CVD risk factors (overweight/obesity, hypertension, high blood glucose, hyperlipidemia) and associated poor health behaviors (smoking, physical inactivity and unhealthy diet).
2) To examine the distribution of 10-year Pooled Atherosclerotic CVD (ASCVD) Risk Scores (PARS10).
3) To examine the predisposing, reinforcing and enabling factors as predictors of elevated CVD risk (≥3 CVD risk factors/ poor health behaviors and Pooled ASCVD risk score ≥7.5%)
4) Examine the association between acculturation and CVD risk factors, poor health behaviors and elevated CVD risk (≥3 CVD risk factors/ poor health behaviors and Pooled ASCVD risk score ≥7.5%)

CONCEPTUAL FRAMEWORK

A modification of the PRECEDE–PROCEED model (PPM), developed by Green and Kreuter[84], was the conceptual framework for the proposed study which will guide planning, implementing and evaluating prevention efforts in the population. This ecological conceptual framework integrates health assessment, health education, social action, and behavioral change and maintenance principles. A crucial tenet of this framework is that health is more than physical well-being or the absence of disease.

Rather, it is a constellation of factors – economic, social, political, ecological, and physical – that add up to healthy, high-quality lives for individuals and communities.

The PRECEDE component of the model which stands for Predisposing, Reinforcing, and Enabling Constructs in Educational/Environmental Diagnosis and Evaluation was initially developed by Green and colleagues in the 1970s. [85] With increased recognition of the importance of the environmental factors as crucial determinants of health, PROCEED (Policy, Regulatory, and Organizational Constructs in Education and Environmental Development) was added to the model in 1991.[86] As ecological and participatory approaches models flourished in the 1990s, the PPM was modified to include these approaches as well as knowledge from the field of genetics. Another crucial tenet of this framework is that the precise social, behavioral, environmental, genetic, social, and ecological determinants of health behavior must be assessed before a program guided by the PPM is effectively implemented.

The PPM has been utilized in CVD and risk factors research in several countries including; Canada[32,87,88],Australia[89] South Africa[34], China[90], USA [91,92]and Sweden[93]. The model has also been applied in diverse populations including a sample of 18-80 year old hypertensives [32] adult hypertensive peri-urban South Africans[34] elderly hypertensive Korean immigrants[91], diabetic Chinese older adults, low- income Hispanic immigrants[90], overweight /hypertensive adults[93] and diabetic African- American adults[92]. To fulfill the aims of the proposed study only *Phase 1* (Social Assessment) and *Phase 2* (Epidemiological, Behavioral and Environmental Assessment) and *Phase 3*(Educational and Ecological Assessment) of the PRECEED portion of the conceptual framework and guided the examination of predisposing, reinforcing and enabling factors and their

interplay with CVD risk factors, poor health behaviors and CVD risk level. **Figure 1.1** illustrates the conceptual framework and roadmap for the study.

SAMPLE SIZE DETERMINATION FOR A PREVALENCE SURVEY, WITH FINITE POPULATION CORRECTION

With an estimated population size of 25,000 WAI residing in the Washington, D.C metropolitan area{{258 Kent, M. 2007}}, and assuming a conservative estimate of a 50% prevalence of HTN and overweight/obesity and precision of 6% and 95% Confidence Interval, a sample size of 264 was needed to determine the prevalence of HTN and overweight/obesity in this population. Using Green's(1991) {{396 Green, S.B 1991}} rule of thumb for determining regression sample sizes, [N > 50 + 8m (m =number of independent variables) would require a minimum sample size of 106 participants each from Ghana and Nigeria to achieve Aims 3 and 4.

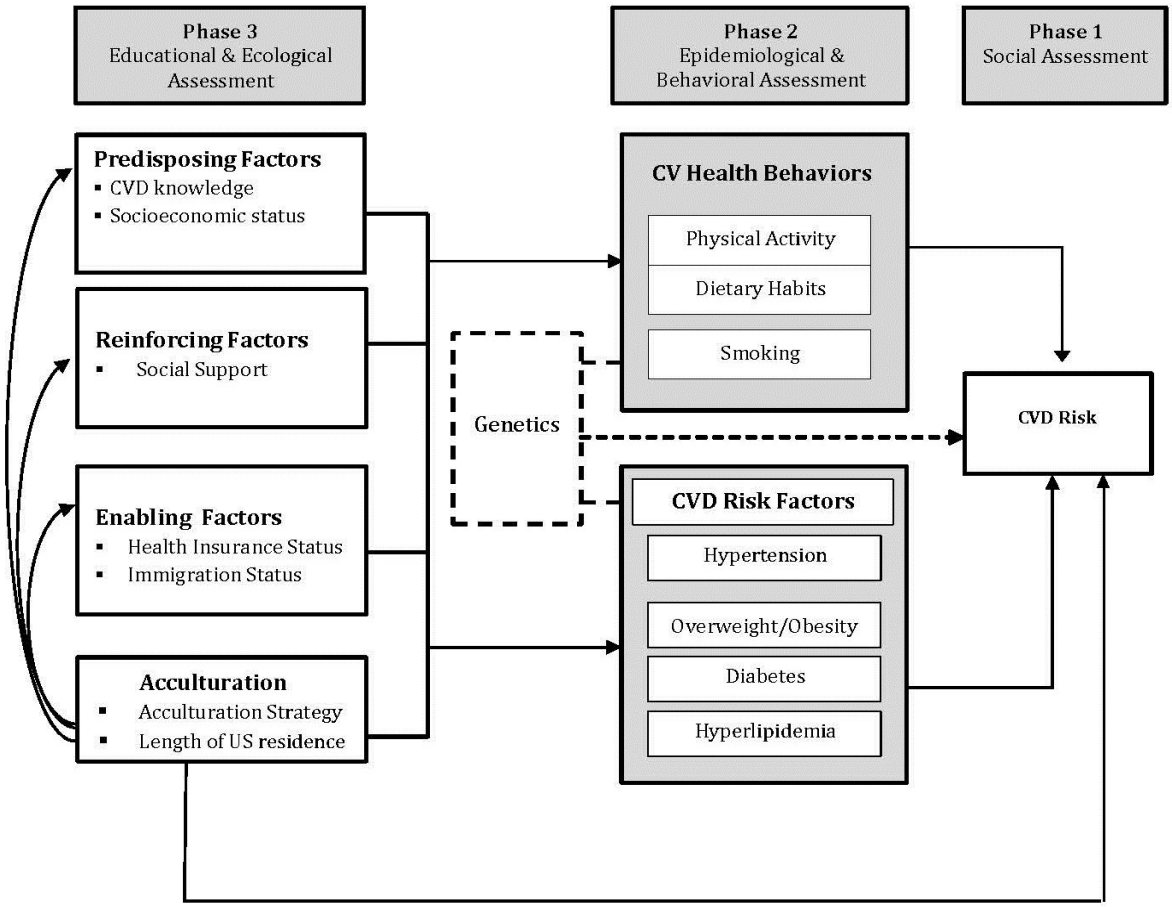

Figure 1.1 Modified PRECEDE-PROCEED MODEL: Conceptual Framework for the Study

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DISSERTATION ORGANIZATION

This dissertation consists of six chapters. **Chapter One** provides a review of relevant literature, overview of the dissertation study include purpose, specific aims, the theoretical framework that guided the study.

Chapter Two (Manuscript One) provides a systematic review on two major CVD risk factors-hypertension and overweight/obesity and Ghanaians and Nigerians. This manuscript was published in 2014, and the citation is as follows:

Commodore-Mensah, Y; Samuel, LJ.; Dennison-Himmelfarb, CR.; Agyemang, C.(2014) Hypertension and overweight/obesity in Ghanaians and Nigerians living in West Africa and industrialized countries: a systematic review. J Hypertens. 2014; 32(3):464-472

Chapter Three (Manuscript Two) is the first data-based manuscript and describes the prevalence of CVD risk factors/ health behaviors, global CVD risk and also identify independent predictors of increased CVD risk by sex among West African immigrants(WAI). Chapter 1 addresses Specific Aims 1-3. This manuscript will be submitted to the International Journal of Epidemiology or Circulation.

Chapter Four (Manuscript Three) is the second data-based manuscript from this dissertation work. . In particular, we reported the associations between acculturation and CVD risk factors, poor health behaviors as well as elevated 10-year CVD risk using the new Pooled Atherosclerotic Cardiovascular Disease (ASCVD) risk score. We hypothesized that the prevalence of CVD risk factors, poor health behaviors and elevated CVD risk would be significantly associated with acculturation. Chapter Four addresses specific aim 4.

Chapter Five presents a concise summary of the dissertation and integrates the findings, including those not described in Chapters 1-5. Study strengths and limitations, and implications of the findings for future research and practice are also presented.

CHAPTER TWO: MANUSCRIPT ONE

Hypertension and overweight/obesity in Ghanaians and Nigerians living in West Africa and industrialized countries: a Systematic Review

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ABSTRACT

Context: There is a growing prevalence of cardiovascular disease (CVD) risk factors in West Africa and among its migrants to industrialized countries. Despite this, no study has reviewed CVD risk factor prevalence among West Africans in Africa and industrialized countries.

Objective: To appraise studies on the prevalence of two CVD risk factors (hypertension and overweight/obesity) among two major West African populations (Ghanaians and Nigerians) in Africa and industrialized countries.

Methods: A comprehensive literature search from 1996 to July 2012 was undertaken to identify quantitative studies on hypertension and overweight/obesity among adult Ghanaians and Nigerians in West Africa and industrialized countries.

Results: Twenty studies were included with 10 conducted in Ghana, six conducted in Nigeria and four in industrialized countries. Studies in Ghana and Nigeria reported a hypertension prevalence of 19.3–54.6% with minimal differences between rural, urban, semi-urban, and mixed populations. Of the hypertensive patients, 14–73% were aware of their condition, 3-86% were on treatment, and 2–13% had controlled blood pressures. Overweight/obesity prevalence in Ghana and Nigeria ranged from 20 to 62% and 4 to 49%, respectively. The four studies in industrialized countries reported a hypertension prevalence of 8.4–55% and overweight/obesity prevalence of 65.7–90%.

Conclusion: Hypertension and overweight/obesity are highly prevalent conditions in West Africa and in its migrants residing in industrialized countries. Urgent measures are needed to prevent CVD risk factors and halt the clinical sequelae.

INTRODUCTION

Cardiovascular disease (CVD) has become the leading cause of death globally [1,2] with a high prevalence of major risk factors for CVD, including tobacco use, alcohol use, hypertension (HTN), high cholesterol, obesity, physical inactivity, and unhealthy diets. CVD is an emerging public health problem in West Africa and especially in Ghana and Nigeria where rapid epidemiological transitions have occurred [3]. These countries were selected for this systematic review because they are both English-speaking West African countries whose inhabitants exhibit similar socio-demographic characteristics, political/historical backgrounds, and have been relatively well studied.

In West Africa, HTN and overweight/obesity have emerged as important regional risk factors for CVD [4,5]. Among 79 cases of sudden cardiac deaths in Ile-Ife, Nigeria, hypertensive CVD was the cause of death in 83.5%, of which only 30.3% were previously diagnosed [6]. Similarly, a case-fatality rate of 43% was reported in 445 Nigerian hypertensive cases that presented to an urban tertiary hospital, suggesting that HTN is a major cause of morbidity [7]. HTN is also a leading cause of renal failure and heart failure in Ghana [8] and in the Greater Accra Region, HTN became the second leading cause of outpatient morbidity in 2007 [9].

Once considered a problem of wealthy nations, the WHO estimates that overweight and obesity have increased dramatically in sub-Saharan Africa (SSA) [10] and the obesity prevalence is trending upward in West Africa [11]. Obesity is also the most prevalent nutrition-related disorder in developed and developing countries [12]. These trends are worrisome as HTN and overweight/obesity are associated with increased morbidity and mortality, and pose a large disease burden for numerous noncommunicable diseases [13-15]. Further, the concurrent prevalence of obesity and malnutrition in West African countries result in an even greater disease burden and pose unique challenges for these settings [16].

Rates of CVD and risk factors among some ethnic groups increase following migration to countries where CVD rates are high, which indicates a substantial environmental influence [17]. There are growing West African populations in industrialized regions [18] . An estimated two to three million people from SSA reside in the European Union [19] and 1.1 million reside in the United States [20]. Although limited, available data suggest that African immigrants in these regions bear a disproportionate burden of CVD and CVD risk factors [21-25].

The purpose of this systematic review, therefore, was to critically appraise existing studies on the prevalence of two major CVD risk factors: HTN and overweight/obesity in two West African populations (Ghanaians and Nigerians) residing in Africa and in industrialized countries.

METHODS

Search strategy for identification of studies

Searches were undertaken using the PUBMED electronic database to identify population-based quantitative studies on HTN and overweight/obesity in adult Ghanaians and Nigerians in Africa, Europe, and North America using relevant diagnostic criteria [26-28]. Articles were included in this review if they were published in English between 1996 and June 2012. To enhance the comprehensiveness of the search, both subject headings and free text searches were implemented. Subsequently, reference lists of relevant identified articles were examined to retrieve other studies that were not indexed by PUBMED. The keywords and medical subject headings (MeSHs) used in the development of the search strategy included Ghana, Nigeria, African immigrants, HTN, high blood pressure (BP), overweight, obesity, risk factors, prevalence, and BMI. All MeSH words and keywords were truncated and exploded to capture as many articles as possible.

Study selection and data extraction

The titles and abstracts of the articles were screened and retrieved from the multiple sources described above. Articles were included if they reported on original prevalence (crude or

adjusted), and contained epidemiological data on HTN and overweight/obesity. The full texts of potentially relevant articles were examined on the inclusion criteria and for methodological soundness. No pooled analysis was performed due to the heterogeneity of study populations. Figure 2.1[29] is the flow chart of study selection and extraction.

RESULTS

Description of studies

Twenty (20) independent studies were included in this review, with 10 studies [30-38] conducted in Ghana, six studies [39-44] conducted in Nigeria, and four studies [45-48] conducted in industrialized countries. No epidemiological studies on HTN and overweight/obesity in Ghanaian or Nigerian immigrants in North America were reported. The majority of studies conducted in Africa were population-based and cross-sectional studies. All the four studies conducted in industrialized countries were cross-sectional. Sample sizes of the studies ranged from 85 to 4733 in Africa and 45 to 1471 in industrialized countries.

Hypertension in Ghanaians and Nigerians residing in Africa

HTN was defined using Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC -7) criteria [26]of SBP at least 140mmHg and/or DBP at least 90mmHg or as individuals being on antihypertensive medication. Notably, some studies also considered individuals who self-reported a prior diagnosis of HTN as hypertensive participants [30-32]. Three studies [34,36,37]restricted their diagnosis of HTN to only one BP measurement. Mean age of participants ranged from 31.6 to 46.8 years in both countries.

Studies in Ghana and Nigeria reported a crude prevalence of HTN between 19.3 and 54.6% (Table 2.1) [30-32,34-43,49]The study by Kunutsor and Powles [37], which reported the lowest crude prevalence rate in a rural Ghanaian population, and the study by Duda *et al*.

[36], which reported the highest crude prevalence among urban Ghanaian women, both only obtained one BP measurement and neither reported adjusted prevalence rates. Notably, only two studies [31,32] adjusted the HTN prevalence rates to the world standard population. Studies in Nigeria reported a crude HTN prevalence between 20.8 [42] and 36.6% [39], whereas their counterparts in Ghana reported a crude prevalence between 19.3 [37] and 54.6% [36]. Minimal differences in HTN prevalence rates were noted between rural, urban, semi-urban, and mixed populations in both countries. In two of the four rural populations, the HTN prevalence was 25% or higher [30,34]. In all six urban populations, the HTN prevalence was 27% or higher. Where reported, there were sex differences in HTN prevalence rates, although no clear pattern was noted (see Table 2.1). Six [34,35,41-43,49]of the 11 studies that analyzed rates by sex reported a higher HTN prevalence in men compared with women.

Detailed analyses of the awareness, treatment, and control of HTN were available for only eight studies conducted in Africa. Of the hypertensive patients, 14–73% were aware of their condition, 3-–86% were on treatment, and 2–13% had controlled BPs less than 140/90mmHg according to the JNC-7 criteria [26]. The highest awareness, treatment, and control rates were observed among urban civil servants in Accra, Ghana [31] and semi-urban participants in Sekondi-Takoradi, Ghana [38] with awareness, treatment, and control rates of 54.1, 31.3, and 12.7 and 73, 59, and 5%, respectively. The worst was observed in a mixed population-based sample of semi-urban and rural participants in the Ashanti region, Ghana where detection, treatment, and control rates were significantly higher in semi-urban (25.7, 14.3, and 3.4%) than in rural villages (16.4, 6.9, and 1.7%) [35]. Generally, women had higher awareness, treatment, and control rates than men [31,35,42,49].

Differences in study populations hinder further analysis of other trends in awareness, treatment, and control.

Overweight/obesity in Ghanaians and Nigerians residing in Africa

All studies except one [43] in this review utilized international criteria for BMI classification [28,50], with normal weight defined as a BMI of 18.5–24.9kg/m^2, overweight 25–29.9, and obesity as at least 30kg/m^2. The study by Oghagbon *et al*. [43] differed by categorizing normal weight as BMI of 20–24.9kg/m^2.

The overall prevalence of overweight and obesity ranged from 20 to 62% and 4 to 49%, respectively (see Table 2.2) [30,31,33-37,40-44,49,51]. Although two of the three rural studies had lower rates of overweight and obesity compared with urban and mixed population, Burket's study [34] was the exception, in which about 44% of the population was found to be overweight or obese. However, a potential selection bias of women (77%) at the market limits the generalizability of the findings. In general, urban studies reported a higher prevalence of overweight or obesity with rates as high as 62%, observed in urban women in the Women's Health Study of Accra. The lowest rate of overweight or obesity (3.9%) [43] was observed in rural Egbegba, Nigeria; however, 60.9% of this population was underweight. This difference in prevalence of overweight or obesity is also reflected in the average BMIs of urban and rural populations in Table 2.2. Five studies [31,34,41,49,52] did not report BMI status by sex. In all studies in which BMI status was reported by sex, women had a higher prevalence of overweight or obesity. This sex disparity in prevalence of overweight or obesity corroborates the findings of systematic review by Abubakari and Bhopal [53]. In all urban studies [31,51], obesity was approximately four times higher in women than men with the exception of study by Duda *et al*. [36], which excluded men. The

prevalence of overweight or obesity was higher in Ghanaians (range of 21.1–62.3%), compared with Nigerians (range of 3.9–49%). Given the frequent concurrence of overweight/obesity and HTN, it is no coincidence that the prevalence of overweight/obesity and HTN are high in majority of the studies that addressed both risk factors as illustrated in Fig. 2.2

Hypertension and overweight/obesity in Ghanaians and Nigerians residing in industrialized countries

There were four studies conducted in industrialized countries that addressed HTN and overweight/obesity in Ghanaians and Nigerians with the results presented in Table 2.3. [45-48] Two studies were conducted in the Netherlands, whereas the other two were conducted in Italy and Australia. Sample sizes ranged from 45 to 1471. The prevalence of HTN in Ghanaians and Nigerians residing in industrialized countries ranged from 8.4 to 55%. Only study by Agyemang *et al*. [48] examined the awareness, treatment, and control of HTN and reported rates of 50, 45, and 33%, respectively.

DISCUSSION

Compared with the earliest epidemiological studies in Ghana and Nigeria, which revealed a low prevalence of CVD and associated risk factors [54], this systematic review found a high prevalence of HTN and overweight/obesity in the two countries, as foretold by Pobee *et al*. [55] in 1979. Also, this review shows that HTN and overweight/obesity are significant problems even in the poorest rural populations [30,34,40,42]. In a relatively young sample with a mean age of 31 years, a crude HTN prevalence of 30.6% [40]was observed. This finding is particularly concerning, considering the fact that an HTN prevalence of 33.5% has been reported in the United States in adults at least 20 years of age [21], but Ghana and Nigeria are more resource-limited settings. Further, rates of HTN in West

African samples, regardless of setting and sample, are comparable to, or higher than the estimated global prevalence rate of 26.4% [56]. These findings should dispel the myth that HTN is only a problem for the wealthy and elderly.

Although Ghanaians have the highest prevalence of fruit and vegetable consumption in comparison to 52 other countries internationally [50], the prevalence of overweight/obesity is high in this review. The prevalence of overweight/obesity in urban women across studies is alarming. Although lower than the prevalence of 80% in African–American women [57], it still has profound public health implications in developing countries, where resources are scarce and malnutrition remains a public health concern [16]. This may be attributed to low physical activity, as epidemiological studies have shown that Ghanaians and Nigerians do not engage in regular physical activity [33,42,52], or to other dietary factors, as Ghanaians and Nigerians consume dietary salt exceeding recommended limits [37]. Several clinical trials have established that interventions to increase physical activity and reduce dietary sodium [58-60] lower BP, and may reduce CVD risk. However, to enhance the effectiveness of these interventions in Ghana and Nigeria, tailoring to the specific population social, economic and cultural context must be considered.

Although considerable progress has been made toward HTN control in western countries, this review shows that West Africa is lagging behind. In comparison to the United States, where awareness, treatment, and control rates of 80.7, 72.5, and 50.1%, respectively, were reported in 2008 [61], the highest corresponding rates were 54.1, 31.3, and 12.7% [32] in Ghanaians. Possible reasons for the poor treatment and control rates include the high cost of medications [62], absence of national treatment guidelines [5], and

misconceptions about HTN [38]. There is an urgent need to improve awareness, treatment, and control of HTN in these two countries to curb the looming epidemic of CVD.

The high prevalence of overweight/obesity in Dutch-Ghanaians (90%) in study by Agyemang *et al*. [48] reviewed deserves great attention and is comparatively higher than rates reported in the United States [57]. Saleh *et al*. [47] reported similar findings in Australian-Ghanaians where 89% of men and 92% of women were overweight or obese. Although the sample size of 45 in the latter study is small, the findings are equally disturbing. These two studies provide the closest estimate of what can be expected in the Ghanaian and Nigerian immigrants in North America. In West Africa, there is a positive social perception about overweight/obesity, as they are taken to mean signs of 'good living' and are associated with wealth, feminine beauty, and freedom from HIV/AIDS [63,64]. This perception could reinforce unhealthy lifestyles that lead to overweight/obesity in African immigrants. It is well known that 75% of the incidence of HTN is related directly to obesity [65]. It is, therefore, important to develop effective treatment strategies for the management of overweight/obesity in order to reduce the occurrence of obesity-related HTN.

No US-based studies were included in this review because African immigrants are often lumped into one racial/ethnic category and classified as `blacks' [66,67], which may include African immigrants, and Afro-Caribbean immigrants. The lack of epidemiological data on CVD risk factors such as HTN and obesity in the recently immigrated West African population residing in the United States limits healthcare providers and policy makers' abilities to address CVD prevention and management of CVD in this rapidly growing population.

LIMITATIONS AND IMPLICATIONS OF FINDINGS FOR FUTURE RESEARCH

The small number of high-quality, large-scale and comparable studies made this review difficult. Establishing a clear link between temporal trends and increasing prevalence of HTN and overweight/obesity was not possible, although the data suggest that the prevalence rates of HTN and overweight/obesity are high. The absence of sex and age-specific estimates limited interpretation and comparison of the data. There is an urgent need for cross-sectional studies on CVD risk factors in African immigrants to the USA and other industrialized countries. Studies should report world-standardized prevalence rates to permit comparisons between age groups, sexes, areas, and time points globally. Furthermore, studies should build on strengths of previous studies including the use of representative samples and large sample sizes. Longitudinal studies of Ghanaian and Nigerian immigrants starting from the time of migration to industrialized nations may adequately characterize the environmental factors that may contribute to the development or progression of CVD risk factors.

CONCLUSION

This review has demonstrated a high prevalence of HTN and overweight/obesity in both urban and rural areas of Ghana and Nigeria. The awareness, treatment, and effective control of HTN in these two countries are unacceptably low. Improving the awareness, treatment, and control of HTN in these two West African countries is critical in reducing and preventing morbidity and mortality from CVD. Overweight and obesity are highly prevalent conditions in Ghanaians and Nigerians residing in West Africa and even greater in their counterparts residing in industrialized countries. The factors that contribute to this phenomenon need to be further explored in future studies. Ghanaians and Nigerians residing in West Africa may have a high risk of CVD due to the high

prevalence and poor management of HTN and overweight/obesity and this risk may further deteriorate upon migration to industrialized countries. Future longitudinal studies will improve our understanding of the evolution of CVD risk in persons who migrate from West African countries to industrialized countries.

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TABLES

TABLE 2.1. CROSS-SECTIONAL STUDIES OF HYPERTENSION IN [A] GHANAIANS AND [B] NIGERIANS IN AFRICA

						HTN Prevalence(Unadjusted, Adjusted †)			*Hypertension*			
Author Name	***Population Type, City***	***(n)***	***Sampling Method***	***Study period***	***Mean age ± SD yrs***	***(M)***	***(F)***	***(Total)***	***Awareness % (n_A/x)****	***Treatment % (n_T/x)****	***Control %(n_C/x)****	***Control %(n_C/n_T)Δ***
[A]GHANA												
Amoah, 2003 [32]	Urban (Accra)	4733	Random cluster	1998	44.3 ± 14.7	-,27.6†	-,29.5†	28.3,28.4†	34 (458/1337)	18 (243/1337)	3.7(49/1337)	20.2(49/243)
Cappuccio, 2004 [35]	Mixed (Ashanti)	1013	Stratified random	2001-2002	54.7±11.3	29.9	28.0	28.7	22.0(64/291)	11.3(33/291)	2.8 (8/291)	24.2(8/33)
Burket,2006 [34]	Rural (Volta region)	287	Convenience	2002	41.8	39.4	30.7	32.8	18.9	-	-	
Spencer, 2005 [38]	Semi-urban	343	Convenience	2002-2003	48	28.7	30.7	30	73(250/343)	43(148/343)	3.6(12/343)	-
Addo, 2006 [30]	Rural (Accra)	362	Convenience	-	42.4± 18.6	24.1	25.9	25.7	32.3(30/93)	12.9 (12/93)	2.2 (2/93)	16.7(2/12)
Duda, 2007 [36]	Urban women (Accra)	1328	2-stage Cluster Stratified Random	2003	46.8 ± 18.0	N/A	54.6	54.6	23.7(309/1328)	52.4(162/309)	2.3(7/309)	4.3(7/162)
Agyemang, 2006 [54]	Mixed (Kumasi)	1431	Random	2004	35.9 ± 0.16	Rural-27 Urban-33.4	Rural-27 Urban-28.9	29.4	34(486/1431)	28 (401/1431)	6.2 (89/1431)	12.2(49/401)
Addo, 2008 [30]	Urban(Accra)	1015	Random	2006	44.0±10.1	31. 7	28	30.3 27.4†	54.1(166/307)	31.3(96/166)	12.7 (39/307)	40.4(39/96)
Kunustor, 2009 [37]	Rural(North)	574	Random	2007	37.75 ±14.05	-	-	19.3	-	-	-	-
[B] NIGERIA												
Oladapo, 2010 [42]	Rural (Egbeba)	2000	Systematic Random	2002-2005	42.1 ± 21.6	21.1	20.5	20.8	14.2(59/415)	2.6(11/415)	-	-
Ekore, 2009 [39]	Urban (Ibadan)	405	Convenience	2007	31.6 ±6.9	34.4	28.3	30.6	-	-	-	-
Adedoyin,2008 [39]	Semi-urban (Ile-Ife)	2097	Multistage Cluster	-	44.2±11.6	36.8	34.7	36.6	-	-	-	-
Oghagbon, 2008 [43]	Urban (Ilorin)	281	Convenience	-	40.34±9.58	29.0	22.9	27.1	-	-	-	-
Ulasi, 2010 [44]	Mixed (Enugu)	1458	Stratified random	-	43.8 ±13.7	-	-	32.8	-	18.9(11.5/59)	-	-
Isezuo , 2011[41]	Mixed (Sokoto)	782	Multistage Cluster	-	38.9±13.9	25.9	23.6	24.8	13.9 (27/194)	85.7 (23/27)	12.5 (2.9/23)	-

Key: "-" Results not reported, †- Age-adjusted to world standard population, *- Control rate calculated with the number of hypertensives (x) as the denominator , and the numerator (nA) is the number of those participants who were aware of their

TABLE 2.2. CROSS-SECTIONAL STUDIES ON OVERWEIGHT/OBESITY IN GHANAIANS AND NIGERIANS RESIDING IN AFRICA

					BMI (kg/m²)												
					Mean age ± SD/Mean age(95% CI)	***%Normal (18.5–24.9)***			***%Overweight (25.0–29.9)***			***%Obese ≥30.0***			***Mean ± SD***		
Author name	***Population Type, Area***	***(n)***	***Sampling Method***	***Study Period***	All	M	F	All	M	F	All	M	F	All	M	F	All
[A]**GHANA**																	
Amoah[51]	Urban (Accra)	4733	Random cluster	1998	44.3 ± 14.7	68.5	46.1	54.9	17.5	27.1	23.4	4.6	20.2	14.1 13.6[†]	22.6 ± 0.1	25.6 ±0.1	24.4 ±0.1
Cappuccio[35]	Mixed (Ashanti)	1013	Stratified random	2001-2002	54.7 ±11.3	-	-	-	-	-	-	-	-	-	20.2 ±3.1	21.1 ±4.6	21.1 ±4.2
Burket [34]	Rural (Volta)	287	Convenience	2002	41.8	-	-	-	-	-	25.5	-	-	9.1	-	-	24.0
Biritwum[33]	Mixed	4231	Random	2003	-	69	60.9	64.6	13.7	17.3	15.6	2.8	7.9	5.5	-	-	-
Addo[30]	Rural (Accra)	362	Convenience	-	42.4 ±18.6	-	-	74	-	-	15.7	-	-	10.2	21.5 ±2.8	23.9 ±5.4	23.2 ±4.9
Duda[36]	Urban	1328	2-stageCluster Stratified Random	2003	46.8 ± 18.0	N/A	29.9	29.9	N/A	27.7	27.7	-	34.6	34.6	N/A	-	-
Agyemang[49]	Mixed (Kumasi)	1431	Random	2004	35.9 ± 0.2	85.9	75.1	79.9	12.3	13.3	12.9	1.9	11.6	7.2	22.0	24.0	23.1 ± 0.04
Addo[31]	Urban (Accra)	1015	Random	2006	44.0 ±10.1	52	27	42.2	34	34	34	9.9	35.5	20	24.7 ±4.3	28.2 ±5.8	26.1 ±5.8
Kunustor[37]	Rural (North)	574	Random	2007	37.8 ±14.1	-	-	-	-	-	-	-	-	-	21.1 ±2.3	22.2 ±3.4	21.8 ±3.1
[B] NIGERIA																	
Oladapo[42]	Rural (Egbeba)	2000	Systematic Random	2002-2005	42.1 ±21.6	32.4	37.4	35.2	1.9	1.8	1.9	1.5	2.4	2.0	22.8 ± 7.9	25.6 ±11.3	-
Ekore[40]	Urban (Ibadan)	405	Convenience	2007	31.6 ±6.9	-	-	-	-	-	22.5	-	-	8.6	-	-	23.7 ±4.3
Oghagbon[43]	Urban (Ilorin)	281	Convenience	-	40.3 ±9.6	71[**]	38.6	62.9	21.9	30	23.9	7.1	31.4	13.21	24.3 ±4.9	24.6 ±4.5	24.4 ±4.8
Ulasi[44]	Mixed (Enugu)	1458	Stratified random	-	43.8 ±13.7	-	-	-	-	-	31.6	-	-	17.3	-	-	23.7 ±4.3
Isezuo[41]	Mixed	782	Multistage Cluster	-	38.9 ±13.9	-	-	-	-	-	-	2.0	5.9	4.3	22.8±3.6	23.2±4.0	23.0±3.8

TABLE 2. 3. STUDIES ADDRESSING HYPERTENSION AND OVERWEIGHT/OBESITY IN [A] GHANAIANS AND [B] NIGERIANS IN INDUSTRIALIZED COUNTRIES

Author name	*Population Type*	*(n)*	*Design*	*CVD Risk factor*	*Results*
Agyemang[45]	Dutch-Ghanaians, Rural &Urban Ghanaians	1471	Cross-sectional	Overweight/Obesity	Overweight/Obesity prevalence: 69.1% (M), 79.5%(F) in Dutch-Ghanaians which was significantly higher than urban Ghanaians : 22.0 %(M), 50.0 %(F) and rural Ghanaians:10.3 %(M), 19.0 %(F)
Dominguez[46]	African Immigrants (Ghanaians, Nigerians, Ivorians,)	83	Cross-sectional	HTN, CVD risk profiles	HTN prevalence: 8.4%, HTN treatment: 0 %. Obesity prevalence:2.2% and significant correlations b/n duration in Italy and weight ($p<.001$), BMI ($p<.0001$), SBP ($p<.01$), & DP ($p<.05$)
Saleh[47]	Ghanaian Immigrants	45	Cross-sectional	HTN, Overweight/Obesity	HTN prevalence: 40% (M), 17% (F), HTN Awareness 29%, Overweight/Obesity prevalence: 71%(M), 65.7%(F), 63% participants had one or more metabolic risk factors.
Agyemang[48]	Ghanaian Immigrants	221	Cross-sectional	HTN, Overweight, Obesity, Diabetes, Smoking, Physical Activity,	HTN prevalence: 55%, HTN Awareness:50%, HTN Treatment: 45%, HTN Control: 33%, Overweight/Obesity prevalence: 90%,

FIGURES

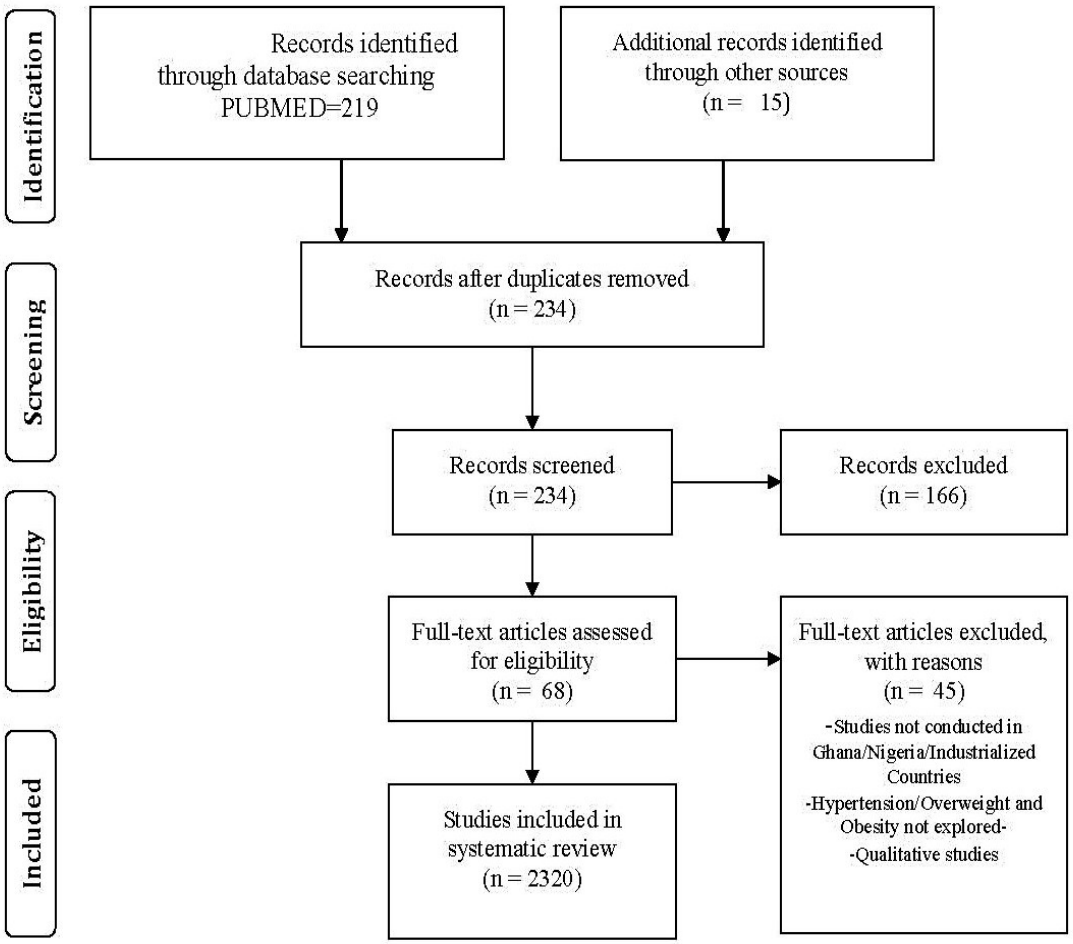

Figure 2.1: Study selection and data extraction. Adapted from [29].

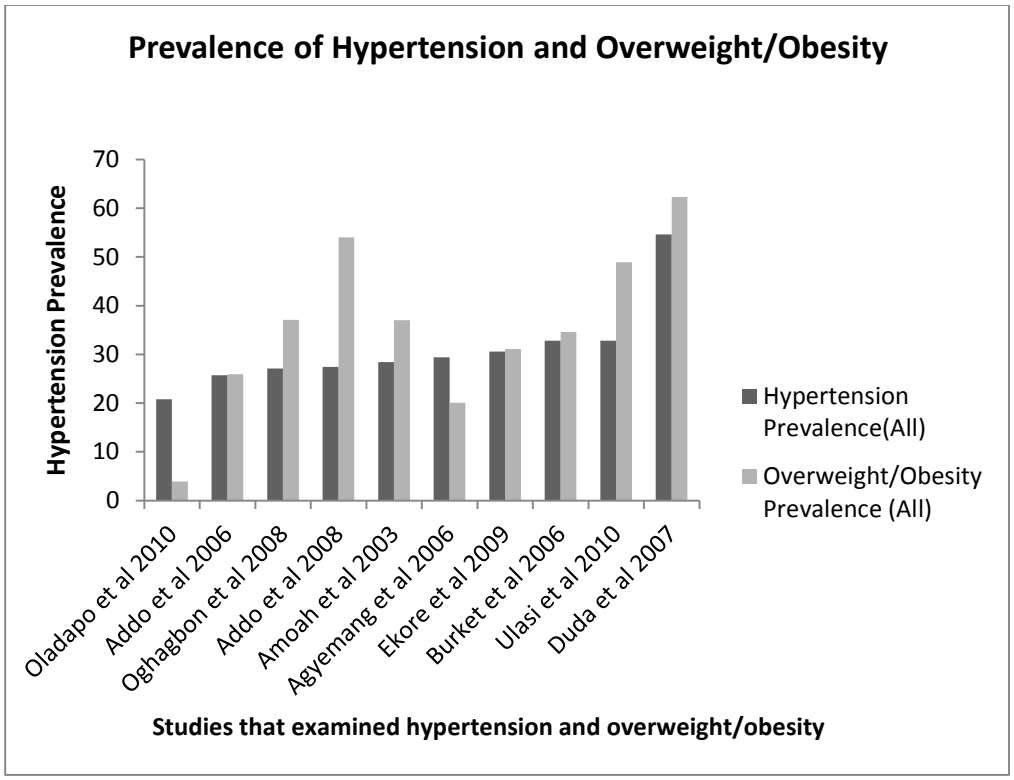

Figure 2.2 Bar chart of studies that examined the prevalence of hypertension and overweight/obesity

CHAPTER THREE: MANUSCRIPT TWO

Cardiovascular Disease Risk of West African Immigrants in the United States-The Afro-Cardiac Study

Yvonne Commodore-Mensah, PhD(c), BSN, RN

ABSTRACT

Background: The number of African immigrants in the United States of America (USA) grew 40-fold between 1960 and 2007, from 35,355 to 1.4 million with a third from the West African countries of Nigeria and Ghana. However, little is known about their health in comparison to Hispanic and Asian immigrants. The purpose of this study is to describe the prevalence of CVD risk factors/ health behaviors (i.e., hypertension, overweight/obesity, diabetes, hyperlipidemia, current smoking and physical inactivity), global CVD risk and also identify independent predictors of increased CVD risk by sex among West African immigrants (WAI).

Methods: Cross-sectional study of West African immigrants (Ghanaians and Nigerians) aged 35–74 years in the Baltimore, Washington-D.C metropolitan area, USA.

Results: The mean age of participants was 49.5±9.2 years and 58% were female. Males were more likely to be employed than females (90% vs. 72%; p=0.001). Only 52% of participants had any health insurance. The majority (95%) had ≥1 CVD risk factors/poor health behaviors. Smoking was the least prevalent as only one male smoked and overweight/obesity was the most prevalent with 88% having a BMI≥25 kg/m^2. Although females were significantly more likely to be treated for hypertension, males (71%) were more likely to have controlled BP than females (42%) [p=0.045]. Prior diagnosis of diabetes or fasting blood glucose level ≥126mg/dL was identified in 16% of the participants. Mean total cholesterol (TC) was 180.9±33.9mg/dL and 32% had TC level ≥200mg/dL. With regards to physical activity, 44% were physically inactive defined as <150minutes/week of moderate or <75minutes/week of vigorous work-related or leisure physical activity. In multivariable analysis, in females, employment [0.18 OR (95%CI: 0.075-0.44)] and having health insurance [0.35OR (95%CI 0.14-0.87)] were associated

with having a pooled ASCVD risk score ≥7.5%. In males, higher social support was associated with a 0.92 (95%CI: 0.84-0.98) odds of having ≥3 CVD risk factors/poor health behaviors but was not associated with pooled ASCVD Risk Score≥7.5%.

Conclusion: The prevalence of CVD risk factors and poor health behaviors among a relatively young group of WAI is particularly alarming and suggests that the "healthy immigrant effect" may no longer hold for recent African immigrants. Employment and having health insurance were protective against high CVD risk in females but only higher social support was protective against high CVD risk in males. CVD prevention strategies in this population must be tailored to the unique needs of the WAI with consideration of socioeconomic status and sex.

INTRODUCTION

Cardiovascular disease (CVD) remains the leading cause of death in the United States of America (USA). Considering that 1 in 3 deaths is attributable to CVD, the prevalence of CVD risk factors and associated poor health behaviors remains high.[1] The Framingham Heart Study[2,3],along with other longitudinal studies, have demonstrated that major CVD risk factors and poor health behaviors including smoking, obesity, hypertension , hyperlipidemia, physical inactivity, and diabetes mellitus act synergistically to increase risk for CVD and death. Similarly, the INTERHEART Study, one of the largest epidemiological global studies of CVD risk factors for acute myocardial infarction, demonstrated that these risk factors and poor health behaviors accounted for 90% of the population-attributable risk (PAR) in men and 94% in women.[4] Likewise, in Sub- Saharan Africa (SSA), CVD is quickly becoming a leading cause of death and disability as a result of the increasing prevalence of CVD risk factors attributed to the "epidemiological transition"; which is characterized by shifts in disease patterns and mortality patterns from infectious diseases to non-communicable disease as major causes of morbidity and mortality. [5]

The influx of African immigrants from SSA to the USA in the past two decades has been unprecedented. The number of African immigrants to the USA grew 40-fold between 1960 and 2007, from 35,555 to 1.4 million, with 36% originating from West Africa. [6] Together, Ghanaian and Nigerian immigrants make up more than 30% of African Immigrants in the USA. The U.S. Census Bureau's 2005 American Community Survey enumerated 114,000 African immigrants in the Washington metropolitan area, accounting for about 11 percent of the area's total immigrant population.[7] Despite the

growing presence of this population in the USA, little is known about the prevalence of CVD risk factors, poor health behaviors and global CVD risk in this population. This research gap stems from the fact that African immigrants in the USA are often lumped into the racial category of "Black/African-American" along with African-Americans and Afro-Caribbeans. Also, research from other immigrant groups such as Hispanic and Asian immigrants cannot be generalized to African immigrants because of the diversity of economic, social and political backgrounds of immigrants. The "healthy immigrant effect" [8,9] suggests that new immigrants are healthier than their host counterparts due to self-selection and immigration policies while immigrants with serious health problems are denied entry into host countries is a well-accepted phenomenon. However, some studies have found that through the process of acculturation, the health of immigrants decline or improve with increasing years of residence in developed countries through the loss of culture-specific health protective practices or adoption of health behaviors of the host society. [9-11] Changes in socio-economic conditions, food supply, health systems and policies, and cultural traditions [12-15] experienced by immigrants have been posited as reasons for deteriorating or improving health. The purpose of this article is to present results from the "Afro-Cardiac Study" and describe the prevalence of CVD risk factors, poor health behaviors and global CVD risk (measured with the Pooled Atherosclerotic Cardiovascular Disease risk score) in West African immigrants (WAI) and also identify factors associated with increased CVD risk.

CONCEPTUAL FRAMEWORK

A modification of the Precede–Proceed model (PPM)[16], was the conceptual framework for the study and will guide future CVD prevention efforts in this population. (**Figure 1.1**). This ecological framework integrates health assessment, health education,

social action, and behavioral change and maintenance principles. To fulfil the aims of the study *Phase 1* (Social Assessment), *Phase 2* (Epidemiological, Behavioral and Environmental Assessment) and *Phase 3* (Educational and Ecological Assessment) of the PRECEED portion of the conceptual framework were used to guide the examination of predisposing, reinforcing and enabling factors and their interplay with CV health behaviors, CVD risk factors and global CVD risk .

METHODS

Design and setting

The "Afro-Cardiac" study was a community-based, cross-sectional study among first-generation WAI aged 35-74 years, born in Ghana or Nigeria and residing in the Baltimore- Washington, D.C metropolitan area. This study targeted Ghanaian and Nigerian immigrants, who compose a relatively homogeneous group, due to shared socio-demographic, political, historical and linguistic factors. According to the 2005 American Community Survey, Ghanaians and Nigerians are two of the largest African-Born Black populations in the USA, with an estimated total population of 25,000, in the Washington D.C Metropolitan area.[7] Quota sampling was used to ensure that comparable proportions of Ghanaians and Nigerians were recruited.

Participants

Participants were recruited from 7 churches attended by African Immigrants in the sampling area because the majority of African immigrants are affiliated with religious institutions. Also, faith-based settings provide access to ethnic minorities and a familiar and reassuring environment for targeting 'hard-to-reach' groups and have provided successful recruitment for other immigrants.[17] Study participants were eligible based on the following criteria: (1) Adults between 35 and 74 years at the time of enrolment; (2)

Self-identify as WAI born in Ghana and Nigeria; (3) Reside in the Baltimore-Washington D.C. metropolitan area and (4) Able to read and write English and provide informed consent. Study participants were excluded from the study if they were pregnant, born in the USA or in another African country. Participants with diagnosed CVD were also excluded because the Pooled Atherosclerotic Cardiovascular Disease risk score (Pooled ASCVD risk score) which is used in this study is derived from participants free of diagnosed CVD.

Recruitment, screening and data collection procedures

Preceding recruitment, the research team was trained on study procedures including obtaining informed consent and research compliance. The research team consisted of medical doctors, nurses, pharmacists and students affiliated with Johns Hopkins Medical Institutions who volunteered to assist with data collection. Participants were recruited between January 2013 and May 2014. An online search of churches attended by African immigrants was performed and religious leaders were contacted to inform them about the study. The religious leaders who expressed interest in the study gave permission to recruit and perform study procedures on church premises. Study flyers were posted at the recruitment sites at least two weeks prior to the date of recruitment at each church. Participants fasted for 8-12 hours prior to church attendance and all examinations were conducted in the morning. On the day of recruitment, the research team described the study to potential participants and conducted a brief screening to determine eligibility and written informed consent was obtained. Trained research assistants collected data, including capillary blood samples; blood pressure (BP), height and waist measures;

and self-administered structured questionnaire. The self-administered structured questionnaire included variables derived from the modified Precede–Proceed model and the WHO STEPS instrument. Following data collection, participants received brief, individualized counselling on reducing CVD risk. An American Heart Association (AHA) booklet on controlling CVD risk factors and poor health behaviors as well as a written summary of the participant's CVD risk profile were provided. Participants were encouraged to share their profile with their primary care providers and received $10 remuneration for their participation.

Ethics

This study was approved by the Institutional Review Board of the Johns Hopkins Medicine Institutions.

Measurement tools and variable definitions

World Health Organization (WHO) (STEPS) Survey

World Health Organization (WHO) Stepwise Approach to chronic disease risk factor surveillance (STEPS) Survey is a simple standardized method for collecting, analyzing and disseminating data on chronic disease risk factors in WHO member countries. Socio-demographic variables and health history data were obtained with a modified version of the WHO STEPS survey with some items tailored to improve relevance to West African immigrants residing in the USA.[18]

Cardiovascular disease risk factors and poor health behaviors

Overweight/Obesity and Central adiposity

Height, weight, waist circumference and hip circumference were measured by trained research assistants for the purposes of assessing body mass index and body fat distribution. Overweight/obesity was defined as body mass index (BMI) ≥25kg/m^2 and ≥30kg/m^2, respectively. Waist circumference (WC) and waist-to-hip ratio (WHR) were measured in addition to BMI because the presence of central adiposity is more highly correlated with cardio-metabolic risk factors than elevated BMI. [19] A WC> 35inches and 40inches and WHR > 0.85 and 0.90 in females and males respectively were considered CVD risk factors. [18]

Hypertension

BP measurements were obtained with the *Lifesource UA-767 Plus* automatic blood pressure monitor. Three BP readings were obtained with 1 minute of rest in between measurements. All participants were seated comfortably with their backs supported and the upper arm bared without restrictive clothing and legs uncrossed. The mean of the second and third systolic BP (SBP) and diastolic BP (DBP) were obtained. Hypertension was defined as self-reported hypertension or history of taking antihypertensive medications per the Seventh Joint National Committee (JNC-7) criteria for the management of high BP in adults. [20]For participants with no history of hypertension, elevated BP was defined as mean SBP ≥140 mmHg or mean DBP ≥90mmHg. Hypertension treatment was defined as self-report of taking antihypertensives in the past two weeks. Hypertension control, defined as the proportion with mean SBP<140mmHg and mean DBP<90mmHg if non-diabetic or mean SBP<130mmHg and

mean DBP<80mmHg if diabetic, was calculated for those with hypertension (treated or untreated) and for those on antihypertensive medications.

Hyperlipidemia

A fasting lipid-profile (total cholesterol[TC], triglycerides [TG] and high-density lipoprotein cholesterol [HDL-C]) and glucose concentrations were obtained with a finger-stick and measured using the POCT instrument-Cholestech LDX analyser (Cholestech Corporation, Hayward, CA, USA). Accuracy and precision of the Cholestech LDX analyser has been previously established. [21] LDL-C levels were measured indirectly using the Friedewald equation. Hyperlipidemia was defined as self-reported history of taking cholesterol lowering medications in the past two weeks or total cholesterol ≥200mg/dL. In this community-based setting, point of contact testing was considered ideal, to limit invasive procedures, provide timely feedback to participants and minimize costs.

Diabetes

Diabetes was defined as self-reported p diagnosis of diabetes or fasting blood glucose levels greater than 126mg/dL.[22] Fasting glucose levels were measured with the Cholestech LDX analyser. Diabetes control was defined as fasting blood glucose levels ≥130mg/dL.[22]

Smoking history

Smoking status (categorized as never, current, and former) was obtained from self-reported history in the modified WHO STEPS questionnaire. Participants were asked to report history of smoking tobacco products including cigarettes, cigars or pipes.

Physical Inactivity

Participants responded to the Global Physical Activity Questionnaire (GPAQ) in the modified WHO STEPS questionnaire and were asked to report moderate and vigorous work-related and recreational physical activity. Participants reporting < 150 minutes per week of moderate intensity work-related/ recreational physical activity or < 75 minutes per week of vigorous intensity work-related or recreational physical activity were classified as not meeting the WHO physical activity recommendations.[18] For statistical analyses, we dichotomized this variable as physically inactive versus physically active (vigorous or moderate intensity activity).

Summative measure of CVD risk factors/poor health behaviors

Having ≥3 CVD risk factors/poor health behaviors is associated with a 10-fold increase in CVD risk. [23,24]. A summative measure of the number CVD risk factors/poor health behaviors was developed to reflect the multiplicative effect of because of CVD risk factors /poor health behaviors in both sexes and dichotomized this variable into <3 and ≥3 CVD risk factors/poor health behaviors.

Pooled Atherosclerotic Cardiovascular Disease Risk Score

We calculated sex-specific Pooled Atherosclerotic Cardiovascular Disease risk score (Pooled ASCVD risk score) using guidelines by Goff et al[25] to estimate the risk of atherosclerotic CVD (ASCVD). This risk score has been shown to predict 10-year risk for developing ASCVD, defined as coronary death or nonfatal myocardial infarction, or fatal or nonfatal stroke. Variables included in the Pooled ASCVD risk score are sex, age, HDL-C, TC, diabetes status, SBP, treatment for hypertension, smoking status and race. Participants were considered to be at "elevated" risk if the predicted Pooled ASCVD risk

score predicted was ≥7.5%. [25] The Pooled ASCVD risk score is considered to be preferable to the Framingham 10-year CVD risk calculation in Blacks because the tool has been validated in contemporary population-based cohorts of Caucasians and African-Americans drawn from the ARIC (Atherosclerosis Risk in Communities) study, Cardiovascular Health Study, and the CARDIA (Coronary Artery Risk Development in Young Adults) study, combined with applicable data from the Framingham Original and Offspring Study cohorts. [25]

Cardiovascular Disease Knowledge

Cardiovascular disease knowledge, a predisposing factor, was measured with the Heart Disease Fact Questionnaire (HDFQ).[26] The questionnaire contains 25 items and demonstrated an adequate internal consistency with Kuder-Richardson-20 formula of 0.63 in this study. Items included in the questionnaire are: "A person always knows when they have heart disease "; "Smoking is a risk factor for heart disease" and "People with diabetes rarely have high cholesterol". Participants responded "True" or "False" to the items and a sum score was developed from correct responses in the questionnaire.

Social Support

Social support, a reinforcing factor, was measured with the Enhancing recovery in coronary heart disease patients (ENRICHD) Social Support Inventory (ESSI). The ESSI is a 7- item self-administered survey which measures three defining attributes of social support including emotional, instrumental, and structural social support. [27]Items were rated on a five- point Likert-scale ranging from "None of the time" to "All of the time" for the first 6 items. The7th item is a dichotomous response to the question, "Are you currently married or living with a partner?" with a positive response scored as 4 points

and a negative response scored as 2 points. The individual items on the ESSI are then summed for a total score, with higher scores representing greater social support. The ESSI reliability in this study was high with Cronbach's alpha of 0.87.

STATISTICAL METHODS

We used independent t-tests and chi-square tests to determine differences in socio-demographic characteristics and cardiovascular disease risk by sex. Categorical data are summarized using percentages and 95% confidence intervals. Continuous data are reported using mean ± standard deviation. To determine if the variables in our conceptual framework (predisposing, reinforcing and enabling factors) independently predicted having ≥3 CVD risk factors and poor health behaviors and Pooled ASCVD risk score ≥ 7.5% , we performed unadjusted and adjusted logistic analyses. For both outcomes, we fit separate logistic regression models for males and females due to the variation in prevalence of CVD risk factors and poor health behaviors by sex. A two-tailed test with $p<0.05$ was considered statistically significant for all analyses. STATA®13 was used to perform all statistical analyses.

RESULTS

Sample characteristics

A total of 256 WAI were recruited from 7 churches in the Baltimore-Washington, D.C metropolitan area. Three participants were excluded from the analysis due to missing data. The demographics of the sample are presented in **Table 3.1**. The mean age of participants was 49.5±9.2 years and 58% were female. A total of 152(60%) participants were born in Ghana and the rest were born in Nigeria. This was a very highly-educated group as 60% of the participants had at least college education. Males were significantly more likely to be employed than females. The high level of education observed in

participants did not translate into higher incomes as only 36% reported a household income > $50,000 with males reporting significantly higher household income than females. Only 52% had health insurance and 77% reported being green-card holders or US citizens and the 23% reported being on a visa or declined to provide that information. Together, green-card holders and U.S citizens were significantly more likely to have health insurance than those on visas or those who declined to provide that information. (61% vs. 20%; p=0.000). A majority (67%) had resided in the USA for 10 years or more with no differences by sex.

Cardiovascular disease risk

The majority of participants (95%) had at least one of the six CVD risk factors or poor health behaviors (hypertension, overweight/obesity, diabetes, hyperlipidemia, current smoking and physical inactivity). Many (80%) had more than one CVD risk factor or poor health behavior: 15% had only one, 26% had two, 30% had three, 15% had four, 7% had five and 2% had all six CVD risk factors or poor health behaviors**.(Figure 3.1)** . Smoking was the least prevalent as only one male smoked and overweight/obesity was the most prevalent with 88% of the participants having a BMI≥25 kg/m^2. With regards to elevated CVD risk, 54% of participants had ≥3 CVD risk factors/poor health behaviors and females were significantly more likely to have ≥3 CVD risk factors/poor health behaviors than males. (63% vs. 42%, p=0.002) However, when we used Pooled ASCVD risk score ≥7.5% as the indicator of elevated CVD risk, only 28% met this criterion with a higher percentage of males (35%) having Pooled ASCVD risk score ≥7.5% than females(23%)[p=0.047]. The distribution of pooled ASCVD scores is provided in **Figure 3.3**. About 34% of the participants had a pooled ASCVD risk score

<2.5% and 13% had a pooled ASCVD risk score≥20%. As shown in **Figure 3.2,** the distribution of risk score in this study is similar to that of the general U. S population.

Hypertension

The mean SBP and DBP were 128.4±19.3mmHg and 80.3±10.9 mmHg respectively with no significant differences by sex **(Table 3.2)**. A total of 40% of the participants had hypertension (prior diagnosis of hypertension or on antihypertensive medications). Among non-hypertensives, 20% of the participants had high blood pressure defined as mean SBP ≥140 mmHg or mean DBP ≥90mmHg or SBP ≥130 mmHg or mean DBP ≥80mmHg if diabetic. About half (53%) of those who had hypertension were on antihypertensive treatment with females more likely to report taking their antihypertensive medication than their male counterparts (64% vs. 36%; p=0.003). Although females were significantly more likely to be treated for hypertension than males, there was no significant difference in hypertension control in those taking antihypertensive medication by sex. We also observed a strong association (X^2 =8.4191, p=0.004) between high waist circumference and hypertension in females but not in males (chi2 0.8417, p=0.359).

Overweight/Obesity and Central adiposity

Anthropometric measurements allowed us to determine the prevalence of overweight/obesity and central adiposity in the sample. The mean BMI was 29.8±4.8 kg/m^2 with females having significantly higher BMIs than males (31±5.1kg/m^2 vs. 28±3.9kg/m$^{2;}$ p<0.00001). **(Table 3.2)**. Similarly, 93% of females were considered overweight/obese in contrast to 81% of males (p=0.002). With regards to central adiposity, only 23% of males had WC >40inches while 75% of females had

WC>35inches (p<0.0001). Similar results were obtained with WHR where 69% of females versus 47% of males had a WHR ratio>0.85(females) and 0.90(males) (p=0.001).

Diabetes

A total of 16% of the participants had a prior diagnosis of diabetes or had fasting blood glucose levels ≥126mg/dL. **(Table 3.2)**. Of those participants, 13% had a prior diagnosis of diabetes with no differences by sex. The mean number of years of diabetes diagnosis was 4.8±3.8years for males and 4.9±3.9years for females (p=0.9559). Females were significantly more likely to be taking medications to control their diabetes than their male counterparts. (80% vs. 43%; p=0.039). Of the diagnosed diabetics, 65% were treated with insulin or an oral glycemic agent in the past two weeks and there was no significant difference in diabetes control (fasting blood glucose<130mg/dL) by sex (57% vs. 63%; p=0.765). We identified 15 participants (6%) who had no prior diagnosis of diabetes but had elevated fasting blood glucose (≥126mg/dL).

Hyperlipidemia

The mean total cholesterol (TC) of the sample was 180.9±33.9mg/dL and 32% of participants had TC levels ≥200mg/dL. Only 2(15%) of the 14 participants who had total cholesterol ≥240mg/dL reported taking cholesterol lowering medications. The mean low density lipoprotein-cholesterol (LDL-C) level was 106±37.3mg/dL and 33% of participants had LDL-C levels greater than or equal to 130mg/dL. A third of participants had low (<40mg/dL in males, <50mg/dL in females) high density lipoprotein-cholesterol (HDL-C) with no differences in prevalence by sex. The mean triglyceride level in this sample was 107.5±86.7 mg/dL with no differences by sex. Only 9% of the sample had

elevated triglyceride levels (≥200mg/dL) with no significant differences by sex. **(Table 3.2)**.

Physical Inactivity

With regards to physical activity, 44% of participants reported low moderate (<150minutes/week) or vigorous (<75minutes/week) work-related or leisure physical activity. Of those participants, 29% reported not participating in work-related or leisure physical activity per week. According to WHO recommended levels of physical activity, only 56% met the recommended weekly physical activity guidelines with no significant sex differences. **(Table 3.2)**.

Determinants of Elevated Cardiovascular Disease Risk (≥3 CVD risk factors & poor health behaviors or Pooled ASCVD Risk Score≥7.5%)

The predisposing, enabling, and reinforcing factors associated with having ≥3 CVD risk factors or poor health behaviors as conceptualized within the conceptual framework are reported in **Table 3.3 and 3.4**. Analyses were stratified because of sex-based differences in cardiovascular risk factor prevalence. CVD knowledge which was considered a predisposing factor was high in this sample with a mean score of 20.5±2.8 (maximum of 25points) but did not independently predict having ≥3 CVD risk factors/ poor health behaviors or ≥ pooled ASCVD risk score 7.5% in both sexes. Employment status, another predisposing factor did not independently predict both outcomes in males. In females, however, employment was associated with an 80% decreased odds of having a pooled ASCVD risk score ≥7.5% . Social support, a reinforcing factor, was operationalized as scores on the ESSI. The mean ESSI score was 28.7± 5.5 with no significant differences by sex. In males, higher ESSI scores was significantly associated

with an 8% lower odds of having ≥3 CVD risk factors & poor health behaviors but not having a pooled ASCVD risk score ≥7.5% . In females, this relationship between social support and having a higher risk for CVD was not observed. We examined having health insurance as an enabling factor and determined that in males, having health insurance was not significantly associated with having ≥3 CVD risk factors and poor health behaviors and high pooled ASCVD Risk Score. However, in females, having health insurance was associated with 65 % lower odds having a high pooled ASCVD Risk Score.

DISCUSSION

To our knowledge, this is the first epidemiological study exploring the prevalence of major CVD risk factors and poor health behaviors and global ASCVD risk in African immigrants in the US. In this contemporary group of WAI, we observed a high prevalence of major CVD risk factors and poor health behaviors. For every 10 participants, 8 had at least two CVD risk factors or poor health behavior and the majority had 3 or more; this calls for immediate attention and public health action to reduce the risk for CVD in this population. This high burden of CVD risk factors and poor health behaviors is particularly troubling given the relatively young age of the participants; nearly 30% percentage were <45 years of age and 94% were <65years. In many African countries, more than half of the CVD deaths are said to occur among persons between 30 and 69 years of age, a range that is 10 years younger than the equivalent age group in Europe and North America.[28,29] Hence, African immigrants in the US may be at high risk for CVD events which may occur at a younger age. However, there is currently no data on CVD events or death in African immigrants in developed countries to support our assertion. In our study, males were significantly more likely to have a

Pooled ASCVD risk score≥7.5% than their female counterparts (7.7±6.4 vs. 5.0±6.9, p=0.047). The distribution of scores was very similar to that of the US population [25] which suggests that our convenience sample closely resembled the distribution of pooled ASCVD scores in the general population **(Figure 5**). Assessing the global risk of ASCVD is clinically relevant to identify high-risk persons, motivate individuals to adhere to risk-reduction strategies and modify the intensity of risk-reduction efforts based on the total risk estimate. Hence, effective primary prevention in WAI requires an assessment of global risk to characterize the population and categorize individuals who will benefit from tailored risk reduction interventions.

We conceptualized that predisposing (CVD knowledge, employment), reinforcing (social support) and enabling factors (health insurance) would each be associated with having elevated CVD risk (≥3 CVD risk factors & poor health behaviors or Pooled ASCVD Risk Score≥7.5%). In fact, we found a significant negative association between social support and elevated CVD risk in men and a negative relationship between employment and health insurance and elevated CVD risk in women. Social support is the emotional, instrumental, and financial aid obtained from one's social network[30] and there is epidemiological evidence that low levels of social support; a psychosocial stressor, is associated with increased incidence of CVD and poor CVD outcomes. [31,32] From a life span perspective, immigration is a significant life transition through which previous social networks and social support may be lost and requires extensive adaptation by immigrants. Socioeconomic status is a powerful determinant of health and is inversely

associated with risk for CVD in high-income countries.[33] However, this relationship is often paradoxical or weak in ethnic minorities with some studies[34,35] reporting no relationship between socioeconomic status and CVD. However, in our study we found that women who were unemployed had a higher risk for CVD than those who were employed. With regards to insurance status, U.S immigrants have some of the highest uninsured rates with 33.5% uninsured among immigrants compared to 12.9% of US-born residents.[36] The uninsured rate in this study was remarkably high with almost half of the participants reporting no health insurance. Participants who were green-card holders or citizens were more likely to be insured than those who were not. This finding of high uninsured rate is troubling because the possession of health insurance facilitates the utilization of preventive services, health outcomes in acute and chronic diseases[37]and is associated with a 40% decreased likelihood of premature death.[38] Of note, data collection occurred during the implementation of the Patient Protection and Affordable Care Act (PPACA), hence it is possible that the current insurance rates in this population may be higher. The impact of this healthcare reform on the insurance rate of this population remains to be seen.

Overweight/ obesity is a well-established risk factor for CVD[4,39] and was most prevalent CVD risk factor with females having significantly higher BMIs than males. The 88% prevalence (81% of men and 93% of women) of overweight/obesity in our sample is higher than the reported 68% prevalence (73% of men and 64%of women) prevalence in US adults[1] and 76% prevalence (69% of men and 82%) African-American adults. [40] Similar findings have been observed by

Agyemang and colleagues[41] in Dutch Ghanaian immigrants(aged 18-60years) where 90% of the participants were overweight/obese. Cultural perceptions may contribute the high prevalence of overweight/obesity in WAI because in West African societies, there is a positive social perception about overweight and obesity, as they are taken to represent signs of 'good living' and are associated with wealth, feminine beauty and freedom from HIV/AIDS.[42,43] This perception could reinforce unhealthy lifestyles that contribute to excess weight gain in WAI.

Central adiposity is also linked to metabolic abnormalities, including insulin resistance, hyperinsulinemia, elevated triglycerides ,glucose intolerance and hypertension [44,45] and in this study females were more likely to have central adiposity than their male counterparts. O'Connor and colleagues have found that in African immigrants, central adiposity may be more predictive of cardiometabolic disease because at a lower BMI and WC than African-Americans, African immigrants had more visceral adipose tissue as well as a higher rate of diabetes and prediabetes than African-Americans.[46] In our study, although 88% of participants were considered overweight/obese, only 53% had a high waist circumference (>35cm in females, >40cm in males). Overall, these finding suggests that the BMI may not be the most reliable indicator of cardiometabolic health in African immigrants though this requires further study.

Hypertension is a major public health problem and in our study, the prevalence was as high as 40%. Although treatment of hypertension lowers CVD risk substantially, we found that only half of those with a prior hypertension diagnosis were taking any antihypertensives. Hypertension control was achieved in only 56% of those being treated

with antihypertensives and 48% of those not treated with antihypertensives. Our findings are well in line with the "rule of halves" where half of the cases were not known, half of those known were not treated and half of those treated were not controlled.[47] Although not assessed in this study, compliance may be a barrier to hypertension treatment and control in WAI. In Beune et al's qualitative study [43] which explored how Ghanaian immigrants in the Netherlands managed hypertension drug treatment, participants stated that they believed fufu (a Western-African starchy staple) caused hypertension and altered their drug dosages for fear of addiction and inability to afford their medications.[48,49] We observed a large sex difference in hypertension treatment where males were significantly less likely to be taking antihypertensives than females. Similar results have been observed in Dutch Ghanaian men who admitted lowering or discontinuing their prescribed antihypertensive medications for fear of the negative effects of antihypertensive medications on their sexual performance. [48] Future studies should explore whether WAI in the US hold similar beliefs. The high prevalence of hypertension and overweight/obesity in this sample could be attributed to low physical activity reported in Ghanaians and Nigerians[50-52] or poor diet, as Ghanaians and Nigerians are said to consume dietary salt exceeding recommended limits[53]. Addressing hypertension and overweight obesity concurrently in WAI is critical in preventing target organ damage and CVD which is more prevalent in persons of African descent. [54]

Type 2 diabetes (T2D) is increasing in prevalence in Africa due to increasing rates of obesity, physical inactivity and urbanization.[55] The high prevalence (16%) of diabetes in this sample may reflect trends that are being observed in SSA where urban residence is

associated with a 2 to 5 times higher risk of impaired glucose tolerance.[56,57] This suggests that WAI may present with even higher risk of diabetes as a result of migration to the US. Since Blacks are said to be 3-5 times more likely to have T2D at a younger age and have higher morbidity and mortality from diabetes and CVD than Caucasians[58] , primary prevention strategies should be implemented in WAI to prevent the development of type 2 diabetes in WAI who are mostly overweight/obese. We identified undiagnosed diabetes in this study which suggests that screening efforts in this population must be improved. O'Connor et al.[46] found that African immigrant men were more likely to have previously undiagnosed prediabetes (35% vs. 22%, $p < 0.01$) and diabetes (8% vs. 0%, $p < 0.01$) and in comparison to African-American men which may be explained by visceral adiposity and more beta-cell failure. The high prevalence of overweight/obesity and central adiposity indicates that if adequate and culturally-appropriate primary prevention efforts are not implemented, the prevalence of T2D may increase with increasing years of US residence. Oza-Frank and Venkat Narayan[59] have also reported that compared to other immigrants in the US, African men ranked second (7.8%) in the prevalence of diabetes while African women (4.57%) ranked third. In Australia[60], a 16% prevalence of diabetes has been reported in Ghanaian immigrants, which is identical to our findings in the US.

Evaluating lipid profile is an integral aspect of assessing CVD risk. However, persons of African descent are said to exhibit normal lipid profiles in the presence of cardiometabolic disease.[61] In our study, the lipid profile of the participants was favorable in comparison to the reported estimates in the general US population. Approximately a third of participants had high LDL-C, high TC and low HDL-C while 1 in 10 participants had high TG levels. In 2008, the US average TC level for adults was about 197 mg/dL,

which is considered desirable[1] and in our study, the average TC level was 181 mg/dL which is also desirable. Although persons of African descent exhibit favorable lipid profile characterized by high HDL-C levels[61,62], it is unlikely that this atheroprotective trait will persist with the acquisition of other CVD risk factors and increased years of US residence. Also, the mean HDL-C level in this sample is higher than what has been observed in West Africans residing in Africa (35 mg/dL) [63] but the TG levels are normal and higher than West Africans residing in Africa(90mg/dL). [63]Elevated TG levels were relatively absent in this group, despite the high prevalence of central adiposity. Hence the traditional definition of metabolic syndrome which relies on 5 metabolic risk factors(central adiposity, high TG, low HDL-C, high BP, and high FBG), may result in the underestimation of CVD risk for WAI. Our finding of high HDL-C conflicts with the low HDL-C level in West Africans in other studies [63-65], and should be explored further. One would expect that migration to the US might result in a decline of HDL-C levels due to dietary and physical activity changes. However, we found that mean HDL-C levels (53.9mg/dL) in our study closely matched those of the US population (52.5mg/dL)

Physical inactivity increases the risk of overweight/obesity, CVD, stroke and metabolic diseases and may very well be one of the most important modifiable risk factors for CVD.[66] Like many developing regions, epidemiological data on physical activity levels in West Africa is limited. The WHO has estimated that 7.9% of males and 15.1% of females were physically inactive in Ghana[67] and in Nigeria, 41% of the population were considered physically inactive. [68] The low levels of physical activity in Africa may be partly explained by environmental and infrastructural barriers such as limited walkways and parks in cities for joggers for running and lack of recreational and sporting

facilities to encourage regular physical activity.[69] Hence, prior to migration West Africans may not engage in recreational physical activity and this poor health behavior may persist post migration. Indeed, in our study, 44% of the participants (44%) did not meet the WHO physical activity recommendations and were considered physically inactive. Similar results were obtained in Ghanaian immigrants in the Netherlands where only 24% of participants engaged in physical activity for more than 30minutes for 5 days/week. Increasing physical activity levels in WAI is an important public health challenge and should be addressed with culturally-appropriate recommendations to reduce the prevalence of overweight/obesity and CVD risk. Social support from friends, family and healthcare providers, perceived access to physical activity and recreational centers, enjoyable scenery and climate, frequently seeing others engaging in physical activity and more walkable neighborhoods are social and environmental factors that influence physical activity in ethnic minorities[70]and must be considered in public health programs that target WAI.

Smoking is the largest preventable cause of death and non-communicable disease globally and the prevalence of smoking in our study was very low with only one male participant reporting a history of smoking. Although, our recruitment of participants from churches may have led to social-desirability and an underestimation of smoking prevalence in WAI, we believe that our findings corroborate other studies which have found a low prevalence of smoking in West Africans. The prevalence of smoking in Ghana is among the lowest in SSA[71] and Owusu-Dabo and colleagues[72] found that the prevalence of self-reported current smoking was 3.8% (8.9% in males, 0.3% in females). Although reliable estimates of smoking prevalence in SSA are scanty, the World Bank

estimates that the prevalence of smoking in Ghanaian men is 10.62%[73] and 2.6% in Ghanaian women[74] and in Nigeria, 10.49% of males[75] and 2.6% of females[76] are said to be smokers. The low prevalence of smoking in women in particular, is a typical finding in African countries and has been attributed to economic constraints and sociocultural contexts in which smokers are considered to be immoral.[77]

There are limitations to this study that are worth noting. First and foremost, this was a cross-sectional study so no causal relationships can be established. Blood pressure levels were based on the elevated BP. Since participants were recruited from churches in the Baltimore, Washington. D.C metropolitan area, they may not be representative of all WAI in the United States. It is possible that participants may have for instance underreported smoking behavior due to social desirability and health behaviors of church attendants may differ from non-attendants and may affect the generalizability of our results. Since this was a cross-sectional study, we were unable to determine whether the pooled ASCVD risk score had adequate discrimination. Also ,the number of African Americans men was relatively low[25] in the validation cohorts from which the Pooled ASCVD risk score is derived which creates some uncertainty with respect to the estimation of CVD risk in this study.

There are strengths to this study that must be considered. To our knowledge, this is the first community based epidemiological study of the prevalence of CVD risk factors and poor health behaviors in African immigrants in the United States and addresses a research gap in an ethnic minority population on whom data is scarce. We also assessed the global risk of ASVD risk using the Pooled ASVCD risk score which has been recommended by the American Heart Association and American College of Cardiology[25]

to replace the traditional Framingham CVD risk score. [78] Furthermore, we utilized a point of care testing system which meets all relevant National Cholesterol Education Program (NCEP) guidelines [79] and allowed for the provision of immediate counselling that could lead to behavior changes and healthier lifestyles. The utilization of WHO STEPS questionnaire which is a cost-effective and standardized surveillance method enhances the comparability of the results obtained from this study to epidemiological studies conducted in West Africa.

CONCLUSION

The "Afro-Cardiac study" complements the existing literature on CVD epidemiology in immigrants in developed countries and provides invaluable insights in a growing yet understudied population of WAI. Overall, our observation is that the "healthy immigrant effect" where immigrants had less obesity, better cardiometabolic health than African-Americans[80,81], may not hold for this current generation of African immigrants. The prevalence of CVD risk factors and poor health behaviors among a relatively young group of WAI is particularly alarming. Males had a significantly higher global CVD risk although females had a striking prevalence of overweight/obesity. Employment was protective against high CVD risk in females and higher social support was protective against high CVD risk in males. In females, not having health insurance was associated with higher CVD risk. Primary prevention strategies including early detection and adequate control of traditional risk factors are critical to combating the global burden of CVD. Early intervention with lifestyle changes and medical management may represent an opportunity to prevent the health of WAI from deteriorating upon migration to the US. Prevention strategies in this population must be tailored to the unique needs of

the WAI with consideration of socioeconomic status and sex. Larger epidemiological studies are needed to confirm our findings. Longitudinal studies are also needed to examine the evolution of cardiovascular disease risk in WAI residing in the US and establish a causal relationship between the variables explored in this study.

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TABLES

DESCRIPTIVE STATISTICS

Table 3.1. Demographic Characteristics of Sample

Characteristic (Mean ±SD or N (%)	**Total** (N=253)	**Males** (n=106)	**Females** n=147)	**p-value**
Age	49.5±9.2	49.7±9.2	49.3±9.2	0.7196
Educational status				
<High School	61(25)	19(18)	42(29)	0.055
High School	38(15)	14(13)	24(17)	
≥College	150(60)	72(69)	77(54)	
Employed	181(79)	81(90)	100(72)	**0.001****
Household Income				
<$25,000	44(18)	16(15)	28(20)	**0.007****
$25,000-$50,000	113(46)	39(38)	74(52)	
>$50,000	88(36)	49(47)	39(28)	
Health Insurance, Yes	127(52)	56(55)	71(49)	0.387
≥10 years of US residence (%)	170(67)	81(76)	89(61)	**0.008****
Green-Card/Citizen	194(77)	84(80)	110(75)	0.385
Country of birth				
Ghana	152(60)	60(57)	92(63)	0.338
Nigeria	101(40)	46(43)	55(37)	

**p<0.05

Table 3.2. Cardiovascular Disease Risk of Sample

Characteristic (Mean ±SD or N (%)	**Total** (N=253)	**Males** (n=106)	**Females** n=147)	**p-value**
Systolic blood pressure(mmHg)	128.4±19.3	130.2±19.8	127.1±19.0	0.223
Diastolic blood pressure (mmHg)	80.3±10.9	79.9±11.6	80.7±10.4	0.594
Elevated blood pressure [a]	28(20)	11(20)	17(21)	0.945
Hypertension diagnosis [b]	98(40)	40(39)	58(41)	0.785
Hypertension treatment [c]	63(53)	17(36)	46(64)	**0.003****
Hypertension Control(On antihypertensives)[d]	24(56)	9(75)	15(48)	0.115
Hypertension Control(No antihypertensives)[e]	11(48)	7(58)	4(36)	0.292
Diabetes diagnosis or FBG>126mg/dL	40(16)	18(17)	22(15)	0.594
Diabetes diagnosis [f]	30(13)	14(15)	16(12)	0.449
On insulin/oral glycemic agents	19(65)	7(50)	12(80)	0.089
Diabetes Control	18(60)	8(57)	10(63)	0.765
Low density lipoprotein-cholesterol(LDL-C)	106.0±37.3	109.6±30.3	103.4±41.5	0.202
LDL-C ≥130(%)	84(33)	38(36)	46(31)	0.448
High density lipoprotein-cholesterol(HDL-C)	53.9±17.9	48.8±14.6	57.6±19.2	**<0.001****
HDL-C<40(M)/<50(F) (%)	74(29)	25(24)	49(33)	0.093
Total Cholesterol (TC)	180.9±33.9	178.1±29.7	183.7±37.3	0.242
TC≥200	69(27)	28(26)	41(28)	0.795
Triglycerides(TG)	107.5±86.7	113.3±83.9	103.5±88.6	0.375
TG≥200	23(9)	11(10)	12(8)	0.546
Body Mass Index (kg/m^2)*	29.8±4.8	28.4±3.9	30.8±5.1	**<0.001****
Normal(18.5-24.9)	30(12)	20(19)	10(7)	**0.002****
Overweight(25-29.9)	112(45)	51(49)	61(43)	
Obese(≥30)	105(43)	33(32)	72(50)	
Waist Circumference>35(F)/40(M)*	127(53)	24(23)	103(75)	**<0.001***
Waist to Hip ratio>0.90(M)/0.85(F)*	151(60)	50(47)	101(69)	**0.001****
Current tobacco smoker	1(0.4)	1(1)	0(0)	0.236
Physical Inactivity	135(56)	58(57)	77(55)	0.754
Pooled ASCVD Risk Score *	6.1±6.8	7.7±6.4	5.0±6.9	**0.002****
Pooled ASCVD Risk Score ≥ 7.5	66(28)	33(35)	33(23)	**0.047****

p<0.05; Elevated blood pressure [a] - Defined as proportion of total sample with mean SBP ≥140 mmHg or mean DBP ≥90mmHg/ mean SBP ≥130 mmHg or mean DBP ≥80mmHg if diabetic. Hypertension diagnosis [b] - Defined as proportion of total sample who self-reported hypertension diagnosis or history of taking antihypertensives per JNC-7 criteria.; ; Hypertension treatment [c] - Defined as proportion of those diagnosed with hypertension who self-reported a history of taking antihypertensives in the past two weeks; Hypertension control(on antihypertensives) [d]- Defined as proportion of those diagnosed with hypertension and treated with antihypertensives who had mean SBP<140mmHg and mean DBP<90mmHg if non-diabetic or mean SBP<130mmHg and mean DBP<80mmHg if diabetic ; Hypertension control(no antihypertensives) [e] - Defined as proportion of those diagnosed with hypertension who were not treated with antihypertensives but had mean SBP<140mmHg and mean DBP<90mmHg if non-diabetic or mean SBP<130mmHg and mean DBP<80mmHg if diabetic . f- Defined as provider diagnosed

Table 3.3: Multivariable logistic regression models for determinants of ≥3 CVD risk factors & poor health behaviors

	Males(N=106)				Females (N=147)			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
Variables	**OR(95%CI)**	**p-value**	**OR(95%CI)**	**p-value**	**OR(95%CI)**	**p-value**	**OR(95%CI)**	**p-**
PREDISPOSING FACTORS								
CVD Knowledge	1.02(0.89-1.16)	0.766	1.06(0.92-1.22)	0.386	1.09(0.97-1.23)	0.159	1.09(0.96-1.23)	0.174
Employment *ref* (Unemployed)	0.59(0.20-1.79)	0.361	0.76(0.22-2.55)	0.657	0.54(0.25-1.20)	0.132	0.55(0.24-1.27)	0.160
REINFORCING FACTOR								
Social Support	0.92(0.85-0.98)	**0.012**	0.91(0.84-0.98)	**0.009****	0.94(0.88-1.01)	0.102	0.94(0.88-1.01)	0.110
ENABLING FACTOR								
Health insurance *ref* (Uninsured)	0.97(0.44-2.09)	0.938	1.11(0.48-2.58)	0.807	0.65 (0.33-1.27)	0.210	0.76(0.38-1.53)	0.439

**p<0.05; [a] Adjusted for remaining predisposing, reinforcing and enabling factors

Table 3.4: Multivariable logistic regression models for determinants of Pooled ASCVD Risk Score≥7.5%

	Males (N=106)				Females (N=147)			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
Variables	OR(95%CI)	P-value	OR(95%CI)	P-value	OR(95%CI)	P-value	OR (95%CI)	OR
PREDISPOSING FACTORS								
CVD Knowledge	1.04(0.90-1.18)	0.612	1.09 (0.94-1.26)	0.281	0.93(0.81-1.06)	0.278	0.91(0.78-1.06)	0.232
Employment *ref* (Unemployed)	0.50(0.17-1.50)	0.214	0.47(0.14-1.54)	0.212	0.15(0.07-0.35)	**<0.0001**	0.18(0.075-0.44)	**<0.0001**
REINFORCING FACTOR								
Social Support	0.95(0.89-1.01)	0.110	0.94(0.87-1.01)	0.081	0.98(0.91-1.05)	0.519	0.97(0.89-1.06)	0.486
ENABLING FACTOR								
Health insurance *ref* (Uninsured)	1.17(0.53-2.57)	0.703	1.48 (0.14-1.54)	0.212	0.28(0.12-0.64)	**0.003**	0.35(0.14-0.87)	**0.024**

**p<0.05; [a] Adjusted for remaining predisposing, reinforcing and enabling factors, CVD-Cardiovascular disease, HTN-

FIGURES

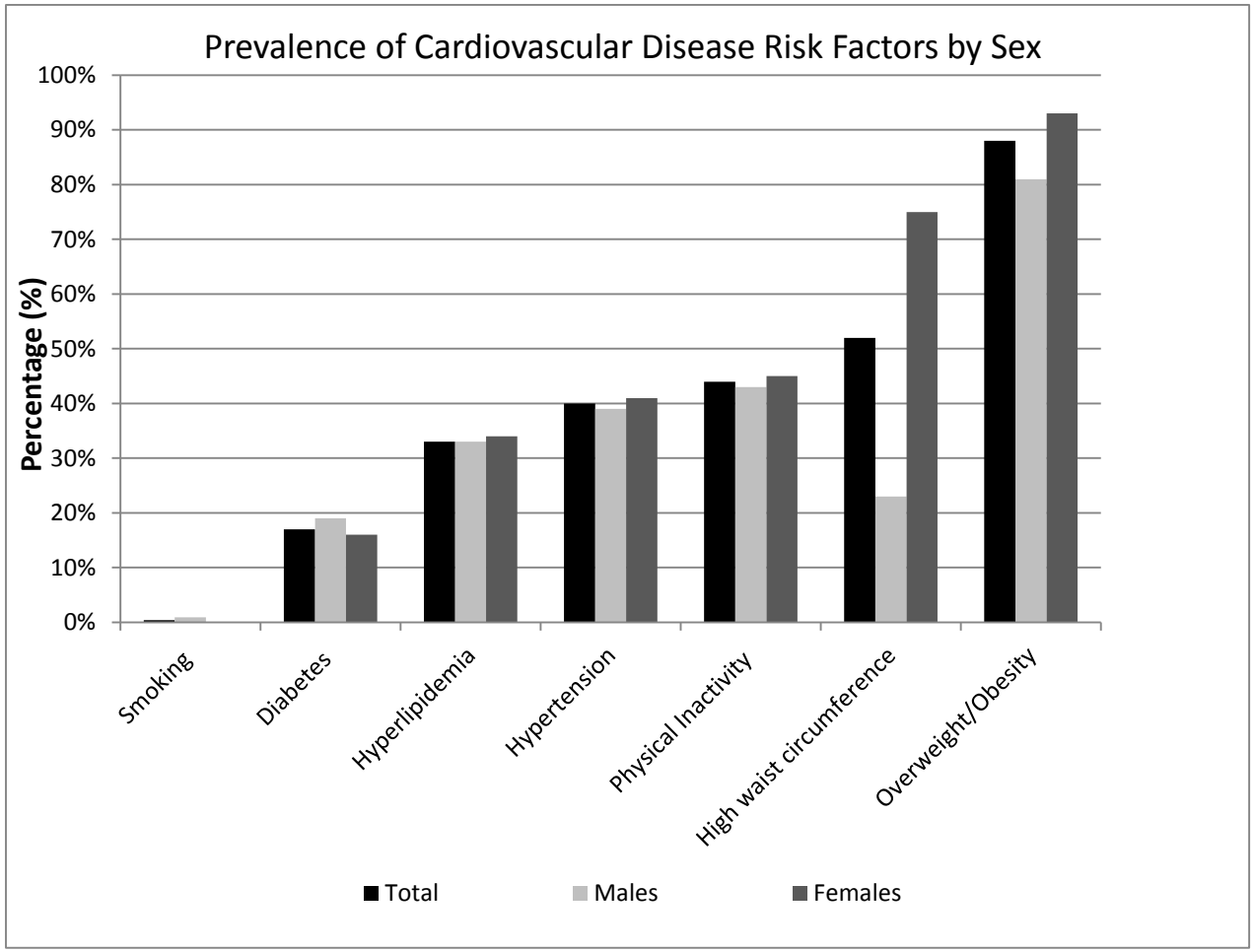


Figure 3.1 : Prevalence of Cardiovascular Disease Risk Factors by Sex

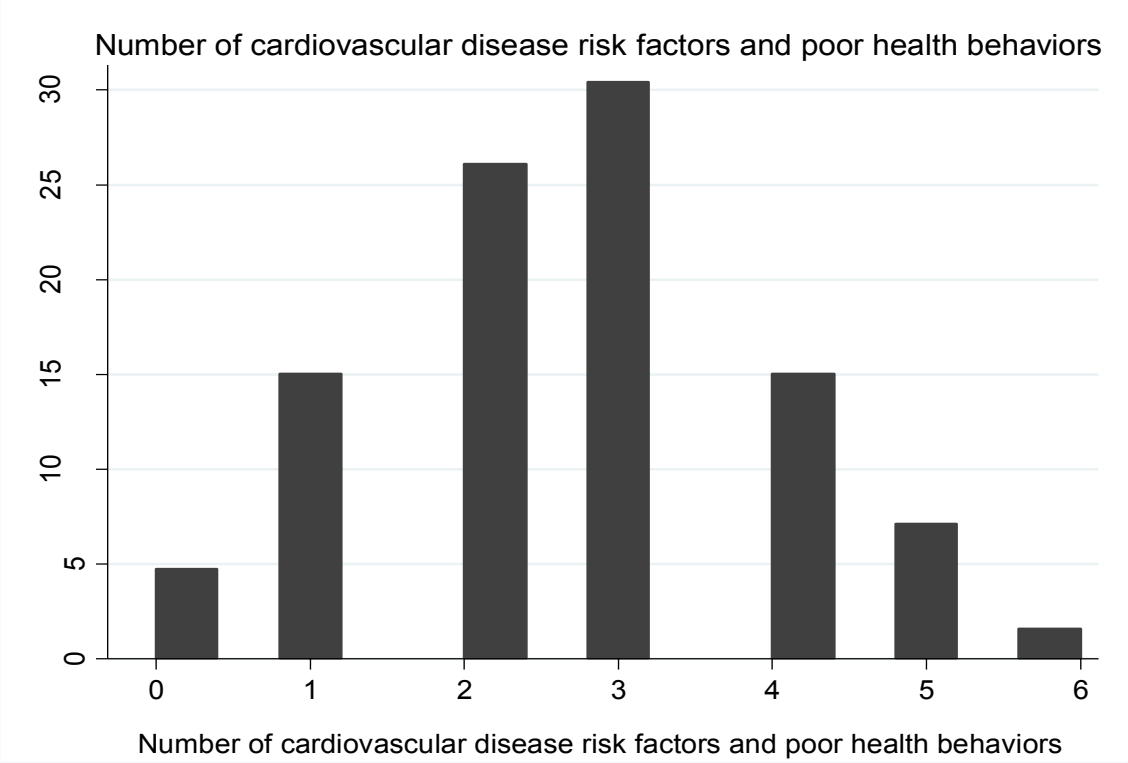
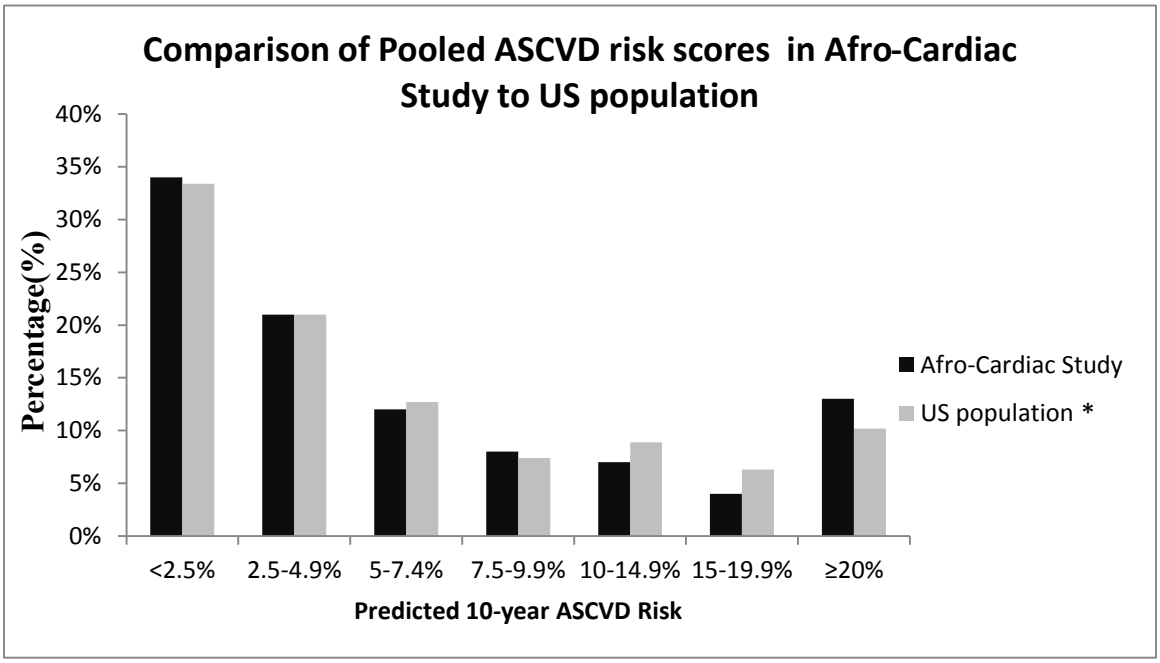


Figure 3.2: Number of Cardiovascular Disease risk factors and poor health behaviors



*** US Population, 40 to 79 Years of Age**[25]

Figure 3.3: Comparison of Pooled ASCVD risk score in Afro-Cardiac Study to US population

CHAPTER FOUR: MANUSCRIPT THREE

Acculturation is associated with Cardiovascular Disease Risk in West African Immigrants (Ghanaian and Nigerian-born) in the United States

Yvonne Commodore-Mensah, PhD(c), BSN, RN

ABSTRACT

Background: Cardiovascular disease (CVD) is the leading cause of death in the United States (U.S.) and the burden of CVD risk factors/poor health behaviors is high in ethnic minorities. In studies of immigrants, acculturation has been associated with the prevalence of CVD risk factors/poor health behaviors and CVD risk. We investigated whether this was true of the burgeoning African immigrant population in the U.S.

Methods: Cross-sectional study of African immigrants (Ghanaian and Nigerian-born) aged 35–74 years in the Baltimore, Washington-D.C metropolitan area, U.S.

Results: Participants (n=253) had a mean age of 49.5±9.2 years and 58% were female. The mean length of U.S residence was 13.6±8.8 years. The prevalence of CVD risk factor/poor health behavior was high with the exception of hyperlipidemia and smoking. Residing in the U.S. for ≥10 years was significantly associated with a 5-fold (95%CI: 1.28-20.33) and 8-fold (95%CI: 2.09-30.80) odds of overweight/obesity and having elevated CVD risk respectively in males. Females who had resided in the U.S. for ≥10 years were 2.60 times (95%CI: 1.04-6.551) more likely to be diagnosed with hypertension than newer residents. Participants also were classified according to acculturation strategy as follows: Integrationists, 166(66%); Traditionalists, 80(32%); Marginalists, 5(2%); or Assimilationists, 2(1%). *Integrationists* had a 0.46(95% CI: 0.24-0.87) lower odds of having ≥3 CVD risk factors/poor health behaviors and 0.38(95% CI: 0.18-0.78) lower odds of having a Pooled ASCVD risk score ≥7.5% than *Traditionalists.*

Conclusion: Although increasing years of US residence was associated with CVD risk, participants who were Integrationists (equally identified with the American and African cultures) had lower overall CVD risk than those who were Traditionalists (identified

more with the African culture). Hence, ensuring the successful integration of African immigrants might reduce the risk of CVD in new African immigrants. These findings suggest that culturally-sensitive tailoring of interventions is needed in this population.

BACKGROUND

Cardiovascular disease (CVD) is the leading cause of mortality and morbidity in the United States (U.S.), accounting for more than 40% of all deaths, with ethnic minorities bearing a disproportionate burden of disease.[1] The prevalence of CVD risk factors and poor health behaviors including hypertension, diabetes, overweight/obesity and physical inactivity is also concerning.[1]

Current trends in globalization have resulted in the migration of Africans in Sub-Saharan Africa (SSA) to developed regions such as Europe and the U.S. The number of African immigrants from SSA in the U.S. increased about 40-fold between 1990-2010.[2] Compared to Africans residing in SSA, those residing in industrialized societes[3-5] have a higher prevalence of CVD risk factors although an epidemic of CVD and metabolic diseases is underway due to the epidemiological transition.[6-8] The causes of increased risk for CVD in African-descent populations in the diaspora are understood incompletely, they may involve socio-economic, environmental, lifestyle changes, and cultural changes[9,10]. In the U.S., Okafor et al[11]reported that dietary change was associated with poorer current self-rated health in African immigrants who participated in the 2003 New Immigrant survey.

Similar to other immigrant groups in the U.S.[12-14], it is likely that acculturation may be associated with the prevalence of CVD risk factors and poor health behaviors and elevated risk for CVD risk in African immigrants. Acculturation has been defined as the "resulting phenomenon when groups of individuals with different cultures come into continuous first-hand contact, and subsequent changes in the cultural patterns of either or both groups".[15] The cultural changes (acculturation) that occur after migration to

different industrialized societies may be detrimental or beneficial to overall health. For instance, in Hispanics, acculturation has been associated with both positive and negative health behaviors. With regards to conferring a lower risk for CVD, increased acculturation had a negative association with increasing body mass index (BMI) and a positive association with improved exercise habits [16], reduced prevalence of obesity and diabetes in males and females [17] in Hispanic Americans. Notably, in the Hispanic Health and Nutrition Examination Survey (HHANES), low acculturation was related to higher prevalence of diabetes and its neuropathic complications in the absence of routine health care. [18] The studies suggesting that increased acculturation increases risk for CVD outnumbered those that show that acculturation improves health. [19,20,21,22] In Hispanic and Asian immigrants, increased acculturation has been found to have a positive association with greater frequency of smoking.[19,20], poor exercise habits [21] and self-reported hypertension[22] coronary artery disease, diabetes and carotid artery intima media thickness.[23]

The relationships between acculturation and CVD risk factors, poor health behaviors and CVD are significant, complex but often inconsistent in prior studies. However, these studies are limited to Hispanic and Asian immigrants residing in the U.S. and to date there have been no published studies on the association between CVD risk and acculturation in African immigrants. Considering the complex and inconsistent relationships between acculturation and CVD observed in other immigrant groups, we sought to examine this relationship in the cross-sectional "Afro-Cardiac study" of acculturation and CVD in African immigrants(Ghanaian and Nigerian-born) residing in the U.S. We reported the associations between

acculturation and CVD risk factors, poor health behaviors as well as elevated 10-year risk for CVD using the new Pooled Atherosclerotic Cardiovascular Disease (ASCVD) risk score. We hypothesized that the prevalence of CVD risk factors, poor health behaviors and elevated CVD risk would be significantly associated with acculturation.

METHODS

Study design and setting

The "Afro-Cardiac Study" was a cross-sectional epidemiological study of West African immigrants(WAI)[Ghanaian or Nigerian born] who reside in the Baltimore-Washington D.C. metropolitan area. The participants were recruited between January 2013 and May 2014 from 7 churches whose members were mostly African. Ghana and Nigeria were chosen because they are both English-speaking West African countries, which have similar socio-demographic, political and historical backgrounds and together make up 30% of West African immigrants(WAIs) in the Baltimore-Washington D.C. metropolitan area. [24] Quota sampling was used to ensure that comparable proportions of Ghanaians and Nigerians were recruited.

Participants

Participants were considered eligible if they met the following criteria: (1) Adults ages 35 and 74 years old; (2) Self-identify as African immigrant born in Ghana or Nigeria, (3) Reside in the Baltimore ,Washington D.C. metropolitan area and (4) Able to read and write English and provide informed consent. Participants were excluded from the study if they were pregnant, born in the U.S. or in another country another African country and did not provide informed consent. Participants with diagnosed CVD were

also excluded from this study as the Pooled ASCVD risk score was derived from a sample free of clinically diagnosed CVD.

Recruitment, screening and data collection procedures

A team of trained research assistant who were medical doctors, nurses, pharmacists and students affiliated with Johns Hopkins University and Medical Institutions assisted with data collection. Preceding recruitment, the principal investigator performed an online search of African churches within the sampling area and contacted the religious leaders to inform them about the study. Religious leaders then provided written consent for the study procedures to be conducted on church premises. All participants remained fasting on the morning of the study. Interested participants were initially screened to determine eligibility and then provided written informed consent. Participants completed a modified version of the World Health Organization Stepwise Approach to Disease Surveillance (WHO-STEPS) questionnaire to determine socio-demographic characteristics and health history.

The trained research team obtained blood pressures, anthropometric measurements and capillary blood samples following recruitment and consent to avoid loss to follow-up between consent and data collection. After data collection, participants were counseled individually on reducing CVD risk. An American Heart Association booklet on CVD risk reduction and a written summary of the participants' CVD risk profile was provided.

Ethics

The Johns Hopkins Medicine Institutional Review Board provided ethics approval for this study.

Variable definitions and measurement

Cardiovascular disease risk factors, poor health behaviors and elevated CVD risk

Hypertension

Hypertension diagnosis was defined as self-reported hypertension or history of taking antihypertensives per the Seventh Joint National Committee (JNC-7) criteria for the management of high blood pressure (BP) in adults. [25] In participants without a history of hypertension, we defined elevated BP as mean SBP ≥140 mmHg or mean DBP ≥90mmHg. Hypertension treatment was defined as self-report of taking antihypertensive medications in the past two weeks. Hypertension control for those on antihypertensives was defined as proportion of those diagnosed with hypertension and treated with antihypertensives with mean SBP<140mmHg and mean DBP<90mmHg . Hypertension control, defined as the proportion with mean SBP<140mmHg and mean DBP<90mmHg if non-diabetic or mean SBP<130mmHg and mean DBP<80mmHg if diabetic, was calculated for those with hypertension (treated or untreated) and for those on antihypertensive medications.

Overweight/obesity

Overweight/obesity was defined as body mass index (BMI) ≥25kg/m^2 and ≥30kg/m^2, respectively. Waist circumference (WC) was measured in addition to BMI because the presence of central adiposity is more highly correlated with cardio-metabolic risk factors than elevated BMI. [26] A WC> 35inches and 40inches in females and males respectively were considered CVD risk factors.[27]

Hyperlipidemia

We obtained a fasting lipid-profile (total cholesterol [TC], triglycerides [TG] and high-density lipoprotein cholesterol [HDL-C]) with the point-of-care-testing system Cholestech LDX analyser (LDX) [(Cholestech Corporation, Hayward, CA, U.S.) Accuracy and precision of the Cholestech LDX analyser has been previously established.[28]

Diabetes

Diabetes was defined as self-reported p diagnosis of diabetes or fasting blood glucose levels greater than 126mg/dL.[29]Fasting glucose levels were measured with the Cholestech LDX analyser. Diabetes control was defined as fasting blood glucose levels ≥130mg/dL. [29]

Physical inactivity

Participants were asked to report moderate and vigorous work-related and recreational physical activity in the Global Physical Activity Questionnaire (GPAQ). Those who reported engaging in no moderate intensity work-related/ recreational physical activity, < 150 minutes per week of moderate intensity work-related/ recreational physical activity or < 75 minutes per week of vigorous intensity work-related or recreational physical activity were classified as not meeting the WHO physical activity recommendations.[27] For statistical analyses, we dichotomized this variable as physically inactive versus physically active (vigorous or moderate intensity activity).

Smoking history

Smoking history was determined by self-report and participants were asked to report any history of smoking tobacco products including cigarettes, cigars or pipes.

Elevated CVD risk measure: Sum of CVD risk factors/poor health behaviors

In order to determine the elevated CVD risk in participants, we created a composite measure of the number of CVD risk factors/poor health behaviors (hypertension, diabetes, overweight/obesity, smoking, hyperlipidemia, physical inactivity). Scores ranged from 0 to 6. In our analyses, we dichotomized the sum score into <3 and ≥3 CVD risk factors/poor health behaviors. Participants with ≥3 CVD risk factors/poor health behaviors were considered to have an elevated CVD risk.

Elevated CVD risk measure: Pooled Atherosclerotic Cardiovascular Disease Risk

We calculated sex-specific Pooled Atherosclerotic Cardiovascular Disease risk score (Pooled ASCVD risk score) using guidelines by Goff et al[30] to estimate the 10-year primary risk of atherosclerotic cardiovascular disease (ASCVD). Variables included in the Pooled ASCVD risk score are sex, age, HDL-C, TC, diabetes status, SBP, treatment for hypertension, smoking status and race. Participants were considered to be at high risk if their calculated Pooled ASCVD risk score was ≥ 7.5%.

Acculturation

Length of residence

Length of residence has been used extensively[12,14] as a proxy measure to determine acculturation level in immigrants and is useful in circumstances where using a more comprehensive acculturation measure is unfeasible.[31] To determine the length of residence in this study, participants were asked to respond to the question "What year did you come to live in the US?" The length of residence was calculated as the current year minus the year of migration to the US. In addition to examining length of residence as a continuous variable, we dichotomized this variable into the categories of <10 years

versus ≥10 years. We used this categorization because previous studies have suggested that CVD risk factors increased substantially after residing in the US for ≥10 years, thus suggesting a threshold effect.[14,32]

Psychological Acculturation Scale

The Psychological Acculturation Scale was originally developed by Tropp et al[33] to assess an individual's sense of emotional attachment to, belonging within, and understanding of the Anglo American and Latino-Hispanic cultures. The original instrument consisted of 10 items on individual's psychological responses to differing cultural contexts. Items were applied to both the American and African culture and were rated on a 5-point Likert scale ranging from "Strongly Disagree to Strongly Agree". **(See Table 4.1)**

Behavioral Acculturation

Two additional items were added to the acculturation instrument to assess behavioral acculturation. **(See Table 4.1.)** Participants were asked how often they spent time with American/Ghanaian/Nigerian people and items were rated from "Never" to "Always". Participants were also asked how many American/Ghanaian/ Nigerian friends they had and their responses ranged from "None" to "Very Many".

Cultural identity

Cultural identity was assessed with the items "I feel American" and I feel Ghanaian/Nigerian". Items were rated on a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree". **(See Table 4.1)**

Acculturation strategy

We determined acculturation strategies used by participants by calculating a composite mean score from the Psychological Acculturation Scale, Behavioral Acculturation Scale and Cultural identity. The acculturation instrument assessed beliefs and behaviors along two dimensions (D1: Relative preference for maintaining the Ghanaian/Nigerian ethnocultural group and D2: Relative preference for having contact with and participating in the American culture.) These two scores obtained from D1 and D2 were then used to identify four acculturation strategies-*Traditionalist, Integrationist, Assimilationist*, and *Marginalist*. A *Traditionalist* resists acculturation and chooses not to identify with another culture and retains separate ethnic identification, behaviors, beliefs, practices and values.[34] In this study, a *Traditionalist* was defined as a participant with mean D1 score≥3 and mean D2 score <3. An *Integrationist* develops a bicultural orientation and successfully integrates both cultures and identifies and feels comfortable with both groups. [34] We defined an *Integrationist* as a participant with mean D1 score ≥3 and mean D2 score ≥3. An *Assimilationist* loses his or her original cultural identity and subsequently acquires a new identity in the second culture. In this study, an *Assimilationist* was defined as a participant with mean D2 score ≥3 and mean D1 score <3. A *Marginalist* gives up his or her original culture for identification with another culture only to be rejected by the new culture. This individual therefore no longer identifies with either culture.[34] We defined a *Marginalist* as a participant with mean D1 score <3 and mean D2 score <3. The Cronbach's alphas for D1 and D2 were 0.94 and 0.88 respectively in this sample.

STATISTICAL METHODS

The statistical analyses were designed to meet 4 goals. The first goal was to describe the demographic characteristics, prevalence of CVD risk factors/poor health behaviours and elevated CVD risk (≥3 CVD risk factors/poor health behaviors & Pooled ASCVD risk score ≥7.5%. Continuous variables were reported as mean ± SD and categorical variables were reported as n(%) . The second goal was to determine whether length of residence (a proxy measure for acculturation) independently predicted each CVD risk factor/poor health behavior. Hence, six multiple logistic regression models were fitted with length of residence in the U.S. as the primary independent variable (reference group <10years). To account for confounding, we adjusted for age, sex, education, income, insurance and employment. These covariates were included due to their clinical relevance, results obtained in univariate analysis and previous studies. In previous studies, these covariates confounded the association between length of residence in the US and presence of a CVD risk factor/poor health behavior.[14,35] For each CVD risk factor and poor health behavior, we fitted separate for males and females due to the variation in the associations between CVD risk factors and poor health behaviors and acculturation by sex.[20,36] In the model where overweight/obesity was the main outcome, physical activity was also added as a covariate. In the model where the dichotomized pooled ASCVD risk score was used as the outcome, age was not included as a confounder because age is used to calculate the pooled ASCVD risk score. Smoking was not included as an outcome because only one participant smoked. The third goal was to determine if there were any significant differences in demographic characteristics, prevalence of CVD risk factors/poor health behaviors and elevated CVD risk by acculturation strategy. Since only 2 and 5 participants were identified as *Assimilationists*

and *Marginalists* respectively, comparisons were performed for *Traditionalists* versus *Integrationists*. Independent t-tests and chi-square tests were used to compare continuous and categorical variable respectively. This analysis allowed us to determine the construct validity of the acculturation instrument in this study as significant differences were expected between the two groups on demographic characteristics, prevalence of CVD risk factors/poor health behaviors and elevated CVD risk. Finally, to determine whether acculturation(length of residence and acculturation strategy) independently predicted having ≥3 CVD risk factors/poor health behaviors or Pooled ASVD risk score ≥7.5, we performed multivariable logistic regression analyses adjusting for sex, education, income, insurance and employment. A two-tailed alpha (α) of 0.05 was specified in all analyses.

RESULTS

Sample characteristics

We recruited 256 African immigrants (Ghanaian or Nigerian born) from 7 churches in the Baltimore-Washington, D.C. metropolitan area. Three participants were excluded from the analysis due to missing data. The demographic and CVD risk characteristics of the sample are presented in **Table 4.2 and Figure 4.1.** The mean age of participants was 49.5±9.2 years and 58% were female. A total of 60% were born in Ghana and the rest in Nigeria. This was a very highly-educated group as 60% of the participants had at least college education. Male participants were significantly more likely to be employed than their female counterparts (90% vs. 72%; p=0.001). The high level of education observed in participants did not translate in higher incomes as only 36% reported a household income greater than $50,000 with males reporting significantly higher household income than females (47% vs. 28%; p=0.0007). Only 52% had health insurance, 77% reported being green-card holders or U.S. citizens and the rest reported

being on a visa or declined to provide that information. Together, green-card holders and U.S citizens were significantly more likely to have health insurance than those on visas or those who declined to provide that information. (61% vs. 20%; p<0.0001). A majority (67%) had resided in the U.S. for 10 years or more with no differences by sex. The mean SBP and DBP were 128.4±19.3mmHg and 80.3±10.9 mmHg respectively with no significant differences by sex. About half (53%) of those who had hypertension were on antihypertensive treatment and half of those had controlled BP. The mean BMI was remarkably high at 29.8±4.8 kg/m^2 and half of the participants had a high waist circumference (>35females, >40males). With regards to physical activity, 44% of participants reported low moderate (<150minutes/week) or vigorous (<75minutes/week) work-related or leisure physical activity. Only one participant reported smoking in this study.

Association between demographic characteristics, CVD risk factors/poor health behaviors, elevated CVD risk and Acculturation Strategy

To establish construct validity of the acculturation strategies that were identified, we examined expected associations with demographic variables and CVD risk factors/poor health behaviors and elevated CVD risk. As shown in **Table 4.3**, a higher proportion of females than males were *Traditionalists* (41% vs. 19 %, p<0.0001)). *Traditionalists* were older than *Integrationists* when they migrated to the U.S. (39.5 ±11.5 years vs. 33.9 ± 8.0 years, p<0.0001). Also, *Integrationists* had resided in the U.S. for an average of 4 years longer *(*15.0±8.9years vs. 10.8±7.6 years, p=0.0003) and spent a greater percentage of their lives in the U.S. (29.7±14.9 vs. 21.7±14.7, p=0.0001)than *Traditionalists Integrationists* were also more likely to be employed (84% vs. 70,

p=0.013) and had higher incomes(x^2 statistic =10.1, p=0.006) than Traditionalists. There was no significant difference in citizenship and health insurance status between *Integrationists* and *Traditionalists*. As illustrated in **Figure 4.1**, the prevalence of CVD risk factors, poor health behaviors and elevated CVD risk (≥3 CVD risk factors/poor health behaviors and Pooled ASCVD risk score ≥7.5%) was generally higher in *Traditionalists* than *Integrationists*. However, a significant difference was observed in the prevalence of high waist circumference (67% vs. 46%, p=0.003) and having ≥3 CVD risk factors/poor health behaviors (65% vs. 49%, p=0.017) for *Traditionalists* than *Integrationists* respectively. Although not shown in Figure 1, hypertensive *Integrationists* were more likely to have controlled BP than hypertensive *Traditionalists* (54% vs 26%, p=0.010)

Association between Length Residence and CVD Risk Factors, Poor Health Behaviors and Elevated CVD Risk

Residing in the U.S. for ≥10 years was significantly associated with a 5-fold (95%CI: 1.28-20.33) odds of being overweight or obese in males but this relationship did not hold in females. Males residing in the U.S for ≥10 years had an 8-fold (95%CI: 2.09-30.80) higher odds of having a high pooled ASCVD Risk Score. Female participants who had resided in the U.S. for ≥10 years were 2.60(95%CI: 1.04-6.551) times more likely to be diagnosed with hypertension than those who were newer residents. (See **Tables 4.4 and 4.5**)

Association between acculturation and elevated CVD risk

Since acculturation was assessed with length of U.S. residence (proxy) and acculturation strategy we used both variables separately in the multivariable logistic

regression analysis. **(See Table 4.6)** In the adjusted analysis, increasing years of U.S. residence was significantly associated with having ≥3 CVD risk factors/poor health behaviors (AOR: 1.06, 95%CI-1.0-1.10) and Pooled ASVD risk score ≥7.5 %(AOR: 1.09, 95%CI -1.05-1.13). In the adjusted analysis with acculturation strategy as the main predictor, we observed that *Integrationists* had a 0.46(95% CI: 0.24-0.87) lower odds of having ≥3 CVD risk factors/poor health behaviors and 0.38(95% CI: 0.18-0.78) lower odds of having a Pooled ASVD risk score ≥7.5% than *Traditionalists*.

DISCUSSION

The primary objectives of this study were to examine the associations between acculturation and CVD risk factors and poor health behaviors as well as elevated CVD risk in WAIs. As we hypothesized, acculturation was significantly associated with the prevalence of CVD risk factors poor health behaviors and elevated CVD risk.

The prevalence of CVD risk factors/poor health behaviors and elevated CVD risk was high in this group of African immigrants. Overweight/obesity was the most prevalent CVD risk factor/poor health behavior and smoking was rare. A total of 40% of participants had a prior hypertension diagnosis and of these**,** 53% reported taking antihypertensive medications. Only 44% of the participants met the WHO recommendations for physical activity. More than half of the participants had ≥3 CVD risk factors/poor health behaviors and 28% had a Pooled ASCVD risk score ≥7.5%.

There is an abundance of literature on the association between measures of acculturation, and CVD risk factors/poor health behaviors and elevated CVD risk.[35,40-42] However, this knowledge is only limited to Asian and Hispanic immigrants in the U.S.. In this study, we found evidence supporting the moderating role of sex on the

relationship between CVD risk factors/poor health behaviors, elevated CVD risk and length of U.S. residence. In males increasing years of U.S. residence was associated with higher adjusted odds of overweight/obesity and Pooled ASCVD risk ≥7.5%. A systematic review by Delavari et al [43] revealed that among immigrants in high income countries, men were more likely to suffer the consequences of the nutritional transition and gain excess weight than females. In females however, fixed findings were observed which may be explained by the complex interplay of cultural influences on body image, physical activity and food choices. Notably, the majority (93%) of females in this study was overweight/obese and Africans may perceive that being overweight reflects wealth, feminine beauty and freedom from HIV/AIDS.[44,45] Several studies have reported a high prevalence of overweight/obesity in Ghanaians and Nigerians [4,7,46] residing in Africa and it likely that with increasing years of U.S. residence they may continue to gain excess weight and increase their risk for CVD and metabolic diseases. Using data from the National Interview Survey, Goel and colleagues[14] observed that among different immigrant subgroups, number of years of residence in the U.S. was associated with higher BMI beginning after 10 years and similar results were obtained in this study. Considering the growing size of the African immigrant population in the U.S., early clinical and public health intervention on reducing the prevalence of overweight/obesity may be a crucial opportunity to prevent excess weight gain and prevent the development of diabetes and other obesity-related diseases. In this study, increasing years of residence in the U.S. was also associated with higher odds of having elevated CVD risk (Pooled ASCVD Risk Score ≥7.5%) in males only. However, females who had resided in the U.S. for ≥10 years had a 2.6odds of having hypertension than those who had lived in the

U.S. for less than 10 years. Studies of other immigrant groups in industrialized societies have revealed each additional year of residence is associated odds of hypertension. [41,47,48]

Although not measured in this study, dietary acculturation may account for the increased risk of CVD with increasing years of U.S. residence. Dietary acculturation has been described as shifts from traditional diets of vegetables, meats, and whole grains to highly processed, high fat, and high sugar foods that are popular and readily available in the U.S.[49] Previous research suggests that in African immigrants, acculturation was associated with increased consumption of diets that are high in sugar, cholesterol and fat[50] which may be explained by the adoption of dietary behaviors associated with Americans of low socioeconomic status (SES). Also, physical activity acculturation which is defined as increased frequency of sedentary activities[49] may contribute to the increased risk of CVD with increased years of U.S. residence. Research on Asian and Hispanic immigrants suggests that higher acculturation may be associated with increased with less physical activity.[49,51] Although physical activity acculturation was not measured in this study, the overall prevalence of physical inactivity (<150minutes moderate intensity/ <75minutes vigorous intensity physical activity per week) was high. Designing and implementing public health interventions to address dietary and physical activity changes may help to reduce the prevalence of CVD risk factors, poor health behaviors and the elevated CVD risk in WAI.

Generally, immigrants face more barriers to quality health care and are less likely to receive the necessary preventive healthcare services[37,52,53] as well as dietary and exercise counselling from their healthcare providers than U.S.-born residents. [14] In this study, only half of the participants had health insurance and this finding has serious

health implications because health insurance moderates the association between acculturation and health status. [37]Having adequate health insurance is crucial because it facilitates the utilization of preventive services, improves general health and physical functioning and health outcomes in acute and chronic diseases[54] and is associated with a 40% decreased likelihood of premature death.[55] In this study, we observed that although *Traditionalists* had higher risk for elevated CVD than *Integrationists*, they were less likely to have controlled blood pressures. This finding was surprising as *Integrationists* had resided in the U.S longer than *Traditionalists*. Other unmeasured confounding factors including health beliefs, health care utilization, self-care behaviors may have accounted for difference in CVD risk and hypertension control between *Integrationists* and *Traditionalists*. Although both groups were about equally insured, health insurance alone may not necessarily guarantee access to primary care [56] which is necessary for CVD risk management.

A unique feature of this study is that in addition to using a surrogate measure of acculturation, we measured acculturation strategies with a validated instrument. We observed that although participants on average had resided in the US for more than 10 years, acculturation strategies differed between participants, with the majority of participants classified as *Traditionalists* and *Integrationists*. The patterns of acculturation in this study fits well into Berry's [34]acculturation framework. Our findings suggest that the process of acculturation differs among African immigrants, with some becoming integrated into the U.S. society and others adhering almost completely to their culture. It is likely that educational level, family structure, enclave residence may contribute to the acculturation strategy adopted by African immigrants. Also, only 5

participants were identified as *Marginalists* and this is not surprising as "people rarely choose such an option". [57] It appears that first generation African immigrants rarely use the *Assimilationist* strategy in the acculturation process and it is unlikely that African immigrants are not attached to their ethnic culture at all. Furthermore, meaningful relations were found between the acculturation strategies, age at migration, and length of U.S. residence, percentage of life spent in the U.S., employment status and income level which supports the validity of the acculturation instrument we used. In this study, females were overrepresented in the Traditionalist strategy group. Notably, findings about the sex-specific nature of acculturation are inconsistent, with some studies reporting significantly higher acculturation to the host culture in males in comparison to females [58,59] while others have found no significant difference. [60]In terms of differences in CVD risk, we observed that *Integrationists* had a lower adjusted odds of having elevated CVD risk than *Traditionalists.* This finding could be explained the higher rate of employment and incomes observed in Integrationists who identified equally with the American and African culture.

One limitation of this study is that our sample may not be representative of the general African immigrant population. Hence our results cannot be generalized to all African immigrants in the U.S. This convenience sample was recruited from African churches in the Baltimore, Washington, D.C metropolitan area and it is possible that church attendants may have significantly different health behaviors and may have different acculturation levels than non-church attendants. In this absence of a sampling frame of African immigrants in the U.S., this recruitment strategy allowed to successfully engage the participants in this research. Another limitation is that this was a

cross-sectional study so no temporal trends could be established. However, the study has strengths that are worth noting. To our knowledge, this is a first study examining the association between CVD risk factors/poor health behavior and elevated CVD risk in African immigrants. We have contributed to the literature on the association between acculturation and health by focusing on an understudied immigrant population and examining contextual factors that may contribute to the acculturation process and CVD risk in African immigrants.

CONCLUSION

As African immigrants become integrated into the U.S. population, it is imperative that we better understand how unhealthy acculturation may be prevented. In this study, we observed that participants who were Integrationists (equally identified with the American and African cultures) had lower risk for CVD and had controlled blood pressures than those who were Traditionalists (identified more with the African culture). Hence, ensuring the successful integration of African immigrants might reduce the risk of CVD in new African immigrants. Results obtained from this study will help develop longitudinal studies assessing the evolution of CVD risk and the long-term impact of acculturation in increasing the prevalence of CVD risk factors/poor health behaviors and elevated CVD risk. Our results suggest that coordinated public health responses to the epidemic of CVD risk factors and poor health behaviors in the U.S. should target understudied immigrant populations and acculturation should be considered as a meaningful predictor of increased CVD risk and as opportunity to tailor interventions.

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TABLES

TABLE 4.1: Acculturation Instrument

D1: Ghanaian/Nigerian Acculturation sub-scale

1. I feel Ghanaian/Nigerian.
2. I share most of my beliefs and values with Ghanaian/Nigerian people.
3. I have a lot in common with Ghanaian/Nigerian people.
4. I feel comfortable with Ghanaian/Nigerian people.
5. Ghanaian/Nigerian people understand me.
6. I feel proud to be part of Ghanaian/Nigerian culture.
7. I understand Ghanaian/Nigerian people.
8. I know how things are done in Ghanaian/Nigerian culture and I feel I can do them easily.
9. I feel confident I know how to act in Ghanaian/Nigerian culture.
10. In Ghanaian/Nigerian culture, I know what's expected of a person in various situations.
11. I know a lot about Ghanaian/Nigerian culture (for example, its history, traditions, and customs).
12. I have Ghanaian/Nigerian friends
13. I spend my free time with Ghanaian/Nigerian people

D2: American Acculturation sub-scale

1. I feel American.
2. I share most of my beliefs and values with American people.
3. I have a lot in common with American people.
4. I feel comfortable with American people.
5. American people understand me.
6. I feel proud to be part of American culture.
7. I understand American people.
8. I know how things are done in American culture and I feel I can do them easily.
9. I feel confident I know how to act in American culture.
10. In American culture, I know what's expected of a person in various situations.
11. I know a lot about American culture (for example, its history, traditions, and customs).
12. I have American friends.
13. I spend my free time with American people

TABLE 4.2: Demographic characteristics and cardiovascular disease risk	
Characteristic [Mean ±SD or N (%)]	**Total(N=253)**
Demographic Characteristics	
Age	49.5±9.2
>=HS Education	188(75)
Employed	181(79)
Household Income	
<$25,000	44(18)
$25,000-$50,000	113(46)
>$50,000	88(36)
Health Insurance, Yes	127(52)
Years of US residence	13.6±8.8
Green-Card/Citizen	194(77)
Ghanaians	152(60)
Nigerians	101(40)
Cardiovascular Disease Risk	
Mean SBP (mmHg)	128.4±19.3
Mean DBP (mmHg)	80.3±10.9
Hypertension diagnosis	98(40)
Hypertension treatment	63(53)
Hypertension Control(On antihypertensives)	30(50)
Hypertension Control(No antihypertensives)	12(38)
Diabetes	40(16)
Low density lipoprotein-cholesterol(LDL-C)	106.0±37.3
LDL-C ≥130(%)	84(33)
High density lipoprotein-cholesterol(HDL-C)	53.9±17.9
HDL-C<40(M)/<50(F) (%)	74(29)
Total Cholesterol (TC)	180.9±33.9
TC≥200	69(27)
Triglycerides(TG)	107.5±86.7
TG≥200	23(9)
Body Mass Index *	29.8±4.8
Normal	30(12)
Overweight	112(45)
Obese	106(43)
WC>35(F)/40(M)*	128(53)
Current smoker, Yes	1(0.4)
Physical Inactivity	135(56)
Pooled ASCVD Risk Score *	6.1±6.8
<7.5% (vs.≥ 7.5%)	170(72)

TABLE 4.3: Comparison of socio-demographic variables by Acculturation Strategy

M±SD or N(%)	Assimilationist N=2	Marginalist N=5	Traditionalist N=80	Integrationist N=166	p-value*
Female	1(50)	5(100)	60(75)	81(49)	**<0.0001**
Age at migration(years)	36.5±3.5	44.4±13.6	39.5±11.5[a]	33.9± 8.0[a]	**<0.0001**
Length of US residence(years)	25.5± 23.3	8.4±5.6	10.8±7.6[a]	15.0± 8.9[a]	**0.0003**
Percentage of Life in the US (%)	37.0±25.8	17.1±12.5	21.7±14.7[a]	29.7± 14.9[a]	**0.0001**
Employed	2(100)	1(20)	56(70)	139(84)	**0.013**
Income (n/%)					
<$25,000	1(50)	0(0)	21(26)	22(13)	**0.006**
$25,000-$50,000	1(50)	3(60)	39(49)	73(44)	
>$50,000	0(0)	2(40)	20(25)	71(43)	
Green card/citizen (n/%)	2(100)	4(80)	61(76)	127(77)	0.836
Health insurance (n/%)	2(100)	1(20)	37(46)	90(54)	0.241

a,. Acculturation strategies with the same superscript were significantly different
*T-test/X^2 test comparing Traditionalist to Integrationist

Table 4.4: Association between CVD Risk Factors/poor health behaviors, elevated CVD risk and Length of Residence: Males (N=106)

	OR (95%CI)		AOR† (95%CI)	
CVD risk factors/poor health behaviors	≥10years	P-value	≥10years	P-value
Overweight/obesity∞	3.47(1.23-9.79)	**0.018**	5.10(1.28-20.33)	**0.021**
Hypertension	1.89(0.70-5.03)	0.205	0.61(0.17-2.14)	0.436
Hyperlipidemia (TC>200)	1.18(0.42-3.34)	0.754	1.20(0.35-4.13)	0.772
Diabetes	6.18(0.77-49.51)	0.086	3.97(0.42-37.44)	0.228
Physical Inactivity	0.76(0.29-1.93)	0.563	0.49(0.15-1.59)	0.236
Elevated CVD risk	≥10years	P-value	≥10years	P-value
≥3 CVD risk factors/poor health behaviors	2.27(0.86-6.03)	0.099	1.22(0.39-3.85)	0.728
*≥7.5% Pooled ASCVD Risk Score	6.48(1.79-23.37)	**0.004**	8.02(2.09-30.80)	**0.002**

OR=Odds ratio, AOR-Adjusted Odds ratio, CI=confidence interval, TC-Total cholesterol
†Adjusted for age, education, income, insurance, employment,
∞ Adjusted for age, education, income, insurance, employment, physical activity
* Adjusted for education, income, insurance, employment.
Significant OR and AOR at $p<0.05$

Table 4.5: Association between CVD Risk Factors/poor health behaviors, elevated CVD risk and Length of Residence: Females (N=147)

	OR (95%CI)		†AOR (95%CI)	
CVD risk factors/poor health behaviors	≥10years	P-value	≥10years	P-value
Overweight/obesity	2.49(0.67-9.26)	0.173	1.23(0.26-5.82)	0.789
Abdominal obesity (WC>35(F)	1.38(0.64-2.99)	0.413	1.05(0.41-2.70)	0.925
Hypertension	2.67(1.29-5.52)	**0.008**	2.60(1.04-6.51)	**0.041**
Hyperlipidemia (TC>200)	1.03(0.49-2.15)	0.947	1.1(0.41-2.48)	0.985
Diabetes	0.73(0.29-1.82)	0.497	0.58(0.18-1.91)	0.371
Physical Inactivity	0.55(0.27-1.10)	0.087	0.88(0.39-2.02)	0.780
Elevated CVD risk	≥10years	P-value	≥10years	P-value
≥3 CVD risk factors or poor health behaviors	1.32(0.66-2.61)	0.423	1.21(0.52-2.81)	0.652
*Pooled ASCVD Risk Score ≥7.5%	0.78(0.36-1.69)	0.526	2.20(0.79-6.06)	0.127

OR=Odds ratio, AOR-Adjusted Odds ratio, CI=confidence interval, TC-Total cholesterol
†Adjusted for age, education, income, insurance, employment
$^{\infty}$ Adjusted for age, education, income, insurance, employment, physical activity
* Adjusted for education, income, insurance, employment*Significant OR and AOR at p<0.05

TABLE 4.6: Association between Acculturation and elevated CVD risk (≥3 CVD risk factors or poor health behaviors or Pooled ASCVD risk score ≥7.5%)

	Unadjusted			Adjusted		
Variables	**OR**	**95%CI**	**P-value**	**AOR**	**95%CI**	**P-value**
≥3 CVD risk factors or poor						
*Length of US residence (proxy)	1.03	1.00-1.07	0.024	1.06	1.0-1.10	**0.001**
+Acculturation Strategies						
Traditionalist	*Ref*	*Ref*	*Ref*	*Ref*	*Ref*	*Ref*
Integrationist	0.51	0.29-0.89	0.018	0.46	0.24-0.87	**0.017**
Pooled ASCVD risk score ≥7.5%						
Length of US residence (proxy)	1.05	1.02-1.08	0.001	1.09	1.05-1.13	**<0.0001**
Acculturation Strategies						
Traditionalist	*Ref*	*Ref*	*Ref*	*Ref*	*Ref*	*Ref*
Integrationist	0.63	0.36-1.12	0.118	0.38	0.18-0.78	**0.008**

* Adjusted for gender, education, income, insurance status, employment status

+ Adjusted for length of US residence, gender, education, income, insurance status, employment status, *Ref*- Reference group

FIGURES

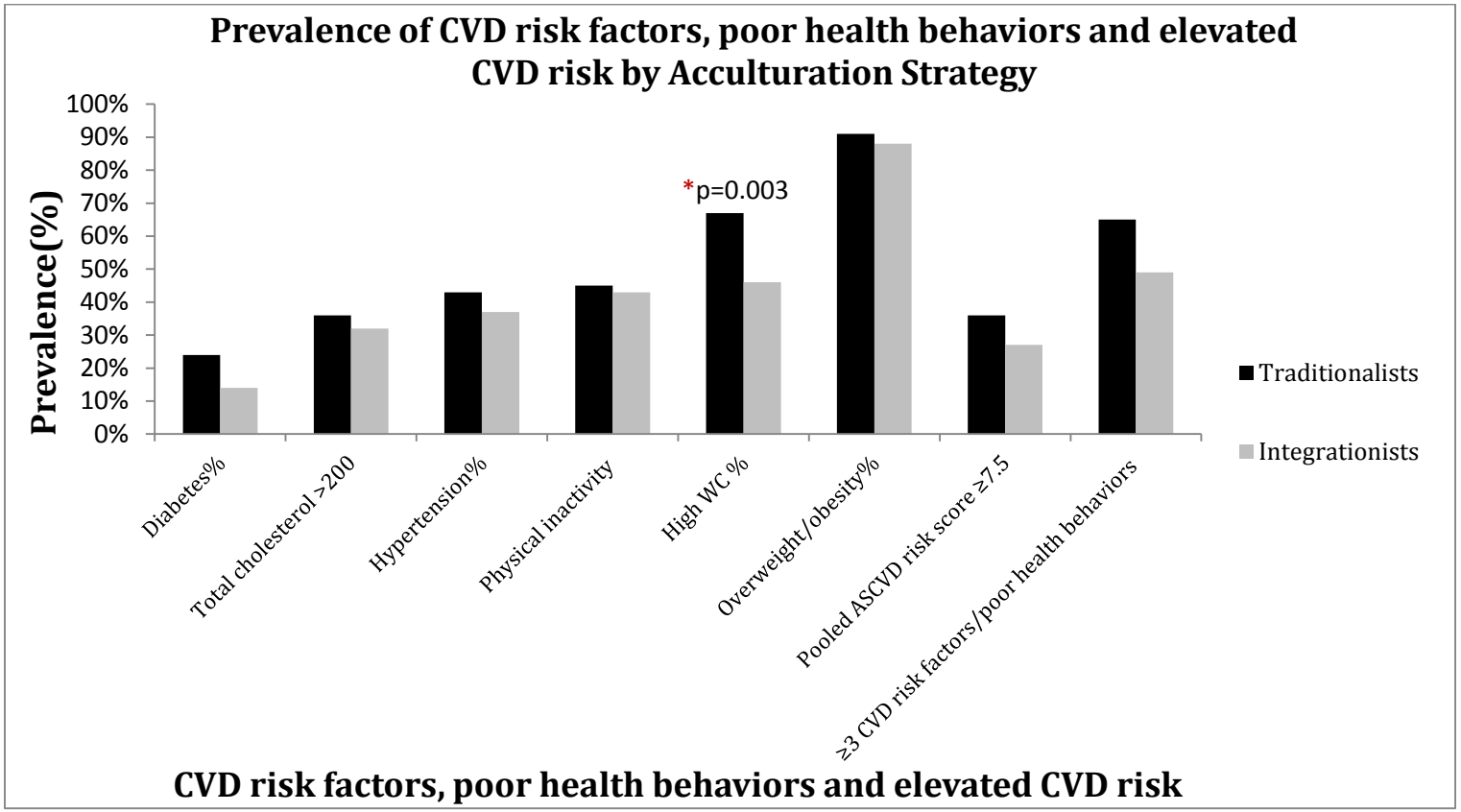

FIGURE 4.1. Prevalence of CVD risk factors, poor health behaviors and elevated CVD risk by Acculturation Strategy

CHAPTER FIVE: DISCUSSION

INTRODUCTION

Cardiovascular disease (CVD) risk factors and poor health behaviors are associated with CVD morbidity and mortality[1] and African-descent populations in industrialized countries are disproportionately affected.[2] Seminal epidemiological studies including "The Framingham Heart Study"[3,4] and "INTERHEART Study"[5] have demonstrated that major CVD risk factors and poor health behaviors such as smoking, obesity, hypertension , hyperlipidemia, physical inactivity, and diabetes mellitus synergistically increase the risk for CVD events. However, these CVD risk factors and poor health behaviors are largely preventable. Sub- Saharan Africa (SSA) is currently facing a double burden of communicable and communicable diseases including CVD, and prevention and treatment strategies are overlooked due to limited healthcare resources.[6] Also, more than half of the CVD deaths in SSA occur among persons between 30 and 69 years of age, a range which is 10 years younger than the equivalent group in Europe and North America. [7,8]

The influx of African immigrants to the US in the last two decades has been unparalleled. The size of this population is said to have grown 40-fold between 1960 and 2007, from 35,555 to 1.4 million, with 36% from the West African countries of Ghana and Nigeria.[9] However little is known about the prevalence of CVD risk factors, poor health behaviors and overall CVD risk. This research gap can be attributed to the fact that "Blacks" in the US are often considered a homogeneous group in research [10]; ignoring the cultural and socioeconomic differences between recent African immigrants and US-born African-Americans. The "healthy immigrant effect"[11,12]which suggests that new immigrants are healthier than their host counterparts is a well-accepted phenomenon.

However, the health of immigrants rapidly declines or improves with increasing years of residence in developed countries through the loss of culture-specific health protective effects or adoption of health behaviors of the host society.[12-14] Changes in socio-economic conditions, food supply, health systems and policies, and culture (acculturation) may be reasons for deteriorating or improving health in immigrants.

Similar to other immigrant groups in the U.S.[15-17], it is likely that acculturation may be associated with the prevalence of CVD risk factors and poor health behaviors and elevated risk for CVD risk in African immigrants. The cultural changes (acculturation) that occur after migration to different industrialized societies may be detrimental or beneficial to overall health. However, to date, there have been no published studies on the association between CVD risk and acculturation in African immigrants.

Identifying predisposing (i.e. CVD knowledge, employment status), reinforcing (i.e. social support) and enabling (i.e. health insurance status) factors is crucial in developing and implementing future CV health interventions in this group. For instance, low socio-economic status measured as income and educational status predicts CVD independently of traditional risk factors included in the Framingham risk score[18-21] and lack of health insurance is associated with increased rates of stroke and death and with less awareness and control of CVD risk factors.[22]However, these determinants have yet to be explored in African immigrants in the US.

The overall purpose of this study was to contribute to the understanding of the CVD risk and the intricate relationships between behavioral, environmental, social and cultural factors among African immigrants residing in the US which will inform

primordial, primary and secondary prevention efforts as well as health policies that directly impact this population.

SUMMARY OF FINDINGS

Sample characteristics

We recruited a total of 256 West African immigrants (Ghanaian and Nigerian-born) from 7 churches in the Baltimore-Washington, D.C metropolitan area and excluded 3 participants due to a high percentage of missing data. The mean age of participants was 49.5±9.2 years and 58% were female. A total of 152(60%) participants were born in Ghana and the rest in Nigeria. Participants were highly-educated as 60% had obtained a minimum of a college education. A higher employment rate was observed in males as compared to females. Although this group was highly educated, only 36% reported a household income > $50,000 with males reporting significantly higher household income than females. Only 52% had health insurance and 77% reported being green-card holders or US citizens and the 23% reported being on a visa or declined to provide that information. Together, green-card holders and U.S citizens were significantly more likely to have health insurance than those on visas or those who declined to provide that information. (61% vs. 20%; p=0.000). A majority (67%) had resided in the USA for 10 years or more with no differences by sex.

Prevalence of CVD risk factors, poor health behaviors, and elevated CVD risk (≥3 CVD risk factors/poor health behaviors and Pooled ASCVD risk score ≥7.5%)

The majority of participants (95%) had at least one of the six CVD risk factors or poor health behaviors (hypertension, overweight/obesity, diabetes, hyperlipidemia, current smoking and physical inactivity). Many (80%) had more than one CVD risk factor or poor health behavior: 15% had only one, 26% had two, 30% had three, 15% had four, 7% had five and 2% had all six CVD risk factors or poor health behaviors. Of the CVD risk factors/ poor health

behaviors, smoking was the least prevalent (only one male smoked); overweight/obesity was the most prevalent (88%). With regards to elevated CVD risk, 54% of participants had ≥3 CVD risk factors/poor health behaviors and females were significantly more likely to have ≥3 CVD risk factors/poor health behaviors than males. (63% vs. 42%, p=0.002) However, when we used PARS10 ≥7.5% as the indicator of elevated CVD risk, only 28% met this criterion with a higher percentage of males (35%) having PARS10 ≥7.5% than females(23%)[p=0.047]. The distribution of PARS10 in this study was similar to the general US population from which the PARS10 was derived.

Predisposing, reinforcing and enabling factors as predictors of elevated CVD risk (≥3 CVD risk factors/ poor health behaviors and Pooled ASCVD risk score ≥7.5%

We conceptualized that predisposing, enabling, and reinforcing factors would be determinants of ≥3 CVD risk factors/ poor health behaviors and PARS10 ≥7.5% as conceptualized within the modified PRECEDE PROCEED Model. CVD knowledge which was considered a predisposing factor was high in this sample with a mean score of 20.5±2.8 (maximum of 25points) but did not independently predict having ≥3 CVD risk factors & poor health behaviors or ≥ PARS10 7.5% in both sexes. Employment status, another predisposing factor did not independently predict both outcomes in males. In females, however, employment was associated with an 80% decreased odds of having a PARS10≥7.5%. Social support, a reinforcing factor, was operationalized as scores on the ENRICHD Social Support Inventory (ESSI). In males, higher ESSI scores were significantly associated with 8% lower odds of having ≥3 CVD risk factors/ poor health behaviors but not having a PARS10≥7.5% . We examined having health insurance as an enabling factor and determined that in males, having health

insurance was not significantly associated with having ≥3 CVD risk factors and poor health behaviors and PARS10≥7.5% However, in females, having health insurance was associated with 65 % lower odds having a PARS10≥7.5%

Association between acculturation and CVD risk factors, poor health behaviors and elevated CVD risk ((≥3 CVD risk factors/ poor health behaviors and Pooled ASCVD risk score ≥7.5%

Association between length residence and CVD risk factors, poor health behaviors and elevated CVD risk

To determine the impact of increasing years of U.S. residence on the prevalence of CVD risk factors, poor health behaviors and having elevated CVD risk, we performed multivariable logistic regression adjusting for age, sex, education, income, insurance and employment. We observed that residing in the U.S. for ≥10 years was significantly associated with 5-fold odds of being overweight or obese in males. Male participants who had resided in the U.S for ≥10 years had an 8-fold (95%CI: 2.09-30.80) higher odds of having a PARS10 ≥7.5%. Female participants who had resided in the U.S. for ≥10 years were 2.60times more likely to be diagnosed with hypertension than those who were newer residents. This relationship was not observed in males.

Association between acculturation and elevated CVD risk

Since acculturation was assessed with length of U.S. residence (proxy) and acculturation strategy we used both variables separately in the multivariable logistic regression analysis. In the adjusted analysis, increasing years of U.S. residence was significantly associated with having ≥3 CVD risk factors/poor health behaviors (AOR: 1.06, 95%CI-1.0-1.10) and Pooled ASVD risk score ≥7.5 %(AOR: 1.09, 95%CI -1.05-1.13). In the adjusted analysis with acculturation strategy as the main predictor, we

observed that *Integrationists* had a 0.46(95% CI: 0.24-0.87) lower odds of having ≥3 CVD risk factors/poor health behaviors and 0.38(95% CI: 0.18-0.78) lower odds of having a Pooled ASVD risk score ≥7.5% than *Traditionalists.* We adjusted for sex, education, insurance status, employment status due to the known confounding relationships between these variables and relationship between acculturation and CVD risk. [23-25]

DISCUSSION SUMMARY

Compared with the earliest epidemiological studies in West Africa(Ghana and Nigeria specifically), which revealed a low prevalence of CVD and associated risk factors [26],the systematic review[27] found a high prevalence of CVD risk factors, particularly, HTN and overweight/obesity in the two countries, as foretold by Pobee et al.[28] in 1979. Treatment and control of CVD risk factors in these two countries are sub-optimal and can be attributed to the high cost of medications [29], absence of national treatment guidelines [30], and misconceptions about CVD risk factors [31]. A high (90%) prevalence of overweight/obesity has been observed in Dutch-Ghanaians[32] . Saleh *et al*. [33] reported similar findings in Australian-Ghanaians where 89% of men and 92% of women were overweight or obese. These two studies provided the closest estimate of what was expected in Ghanaian and Nigerian immigrants residing in the US. The high prevalence of overweight/obesity in West African immigrants may be attributed to low physical activity, as epidemiological studies have shown that Ghanaians and Nigerians do not engage in regular physical activity [34-36], or to other dietary factors, as Ghanaians and Nigerians consume dietary salt exceeding recommended limits [37].

At the time the systematic review[27] was performed, there were no recent published studies on the prevalence of CVD risk factors/poor health behaviors and overall CVD risk in African immigrants. This was surprising given the growing presence of African immigrants in the U.S. It is estimated that approximately 114,000 African immigrants resided in the Washington D.C metropolitan area in 2005, accounting for 11% of the area's total immigrant population.[38] Almost a decade later, it is likely that the size of this population has doubled. African immigrants in the US arrive through different mechanisms including permanent residence through family ties, refugee status, student

visas and diversity visa lottery program. With regards to socioeconomic status, African immigrants in the US are highly educated [25] and more likely to participate in the labour force than all foreign-born Americans [9] They are also more likely to speak English than Asian and Hispanic immigrants.[9,39] These important socioeconomic characteristics likely influence CVD risk and support the need to examine these determinants in African immigrants in the US.

Based on the findings from the systematic review and gaps in knowledge of the CVD risk of African immigrants in the US, we designed the "Afro-CardiAc Study". The purpose of this study was to contribute to examine the relationships between CVD risk and behavioral, environmental, social and cultural factors among African immigrants residing in the US to inform primordial, primary and secondary prevention efforts. This study also examined the association between acculturation, measured by length of US residence and acculturation strategy, and the prevalence of CVD risk factors, poor health behaviors and elevated CVD risk (≥3 CVD risk factors/ poor health behaviors and PARS10 ≥7.5%).

To meet the study goals, we designed a cross-sectional epidemiological study of West African immigrants (Ghanaian and Nigeria-born) residing in the Baltimore, Washington, D.C metropolitan area. We recruited participants from 7 different churches whose attendants were primarily African immigrants to ensure a representative sample. In the absence of an accessible nationality-wise classification of residents in the US we used quota sampling to ensure that comparable proportions of Ghanaians and Nigerians were recruited. The participants were diverse in terms of tribal affiliations, occupation,

income, education and age. The research study was well received by leaders of the churches who provided consent for recruitment to occur on their premises. The faith-based setting provided successful recruitment in this study and has been shown to provide access to ethnic minorities and a familiar and reassuring environment for 'hard-to-reach' groups with high CVD risk[40].

In this contemporary group of WAI, we observed a high prevalence of major CVD risk factors and poor health behaviors. For every 10 participants, 8 had at least two CVD risk factors or poor health behavior and this calls for immediate attention and public health action to reduce the risk for CVD in this population. This high burden of CVD risk factors and poor health behaviors is particularly troubling given the relatively young age(mean age 49years) of the participants; nearly 30% percentage were <45 years of age and 94% were <65years. In many African countries, more than half of the CVD deaths are said to occur among persons between 30 and 69 years of age, a range that is 10 years younger than the equivalent age group in Europe and North America.[7,8] Hence, African immigrants in the US may be at high risk for CVD events which may occur at younger ages. However, there is currently no data on CVD events or death in African immigrants to support our assertion. In this study, males were significantly more likely to have a PARS10≥7.5% than their female counterparts. Of note, in the validation studies for the PARS10, the calibration slope was near 1 for all race-sex groups, but highest in African American females, with a slight tendency to underestimate risk. It is possible that this observation may apply to African immigrant women. However, without longitudinal data, we are unable to support this assertion. . The distribution of PARS10 scores was

very similar to that of the US population [41] which suggests that our convenience sample closely resembled the population from which the risk score was derived.

We theorized that there would be significant associations between predisposing (CVD knowledge, employment), reinforcing (social support) and enabling factors (health insurance) and elevated CVD risk (≥3 CVD risk factors & poor health behaviors or PARS10≥7.5%). A significant negative association was observed between social support and elevated CVD risk in men and a negative relationship between employment and health insurance and elevated CVD risk in women. There is epidemiological evidence that low levels of social support; a psychosocial stressor, is associated with increased incidence of CVD and poor CVD outcomes. [42,43] From a life span perspective, immigration is a significant life transition through which previous social networks and social support may be lost. Socioeconomic status is a powerful determinant of health and is inversely associated with risk for CVD in high-income countries.[18] However, this relationship is often paradoxical or weak in ethnic minorities with some studies[15,44] reporting no relationship between socioeconomic status and CVD. However, in our study we found that women who were unemployed had a higher risk for CVD than those who were employed. With regards to insurance status, U.S immigrants have some of the highest uninsured rates with 33.5% uninsured among immigrants compared to 12.9% of US-born residents.[45] The uninsured rate in this study was remarkably high with almost half of the participants reporting no health insurance. Participants who were green-card holders/U.S citizens were more likely to be insured than those who were not. This finding of high uninsured rate is troubling because the possession of health insurance facilitates the utilization of preventive services, health outcomes in acute and chronic diseases[46]and

is associated with a 40% decreased likelihood of premature death.[47] Of note, majority of the data collection occurred during the implementation of the Patient Protection and Affordable Care Act (PPACA), hence it is possible that the current insurance rates in this population may be higher.

There is an abundance of literature on the association between measures of acculturation, and CVD risk factors/poor health behaviors and elevated CVD risk.[48-51] However, this knowledge is only limited to Asian and Hispanic immigrants in the U.S. In this study, we found evidence supporting the moderating role of sex on the relationship between CVD risk factors/poor health behaviors, elevated CVD risk and length of U.S. residence (a proxy measure for acculturation). In males increasing years of U.S. residence was associated with higher adjusted odds of overweight/obesity and PARS10 ≥7.5%. A systematic review by Delavari et al [52] revealed that among immigrants in high income countries, men were more likely to suffer the consequences of the nutritional transition and gain excess weight than females. In females however, fixed findings were observed which may be explained by the complex interplay of cultural influences on body image, physical activity and food choices. Notably, the majority (93%) of females in this study was overweight/obese and in many Africans there is positive social perception about overweight and obesity in Africa, as they may represent wealth, feminine beauty and freedom from HIV/AIDS.[53,54] Several studies have reported a high prevalence of overweight/obesity in Ghanaians and Nigerians [27,55,56] residing in Sub-Saharan Africa and it likely that with increasing years of U.S. residence they may continue to gain excess weight and increase their risk for CVD and metabolic diseases. Considering the growing size of the African immigrant population in the U.S.,

early clinical and public health intervention on reducing the prevalence of overweight/obesity may be a crucial opportunity to prevent excess weight gain. In this study, increasing years of residence in the U.S. was also associated with higher odds of having elevated CVD risk (Pooled ASCVD Risk Score ≥7.5%) in males although this relationship was not observed in females. However, females who had resided in the U.S. for ≥10 years had a 2.6odds of having hypertension than those who had lived in the U.S. for less than 10 years. Studies of other immigrant groups in industrialized societies have revealed each additional year of residence is associated odds of hypertension. [49,57,58]

A unique feature of this study is that in addition to using a surrogate measure of acculturation, we measured acculturation strategies with a validated bidimensional instrument. We observed that although participants on average had resided in the US for more than 10 years, acculturation strategies differed between participants, with the majority of participants classified as *Traditionalists* and *Integrationists.* Our finding suggests that the process of acculturation differs among African immigrants, with some becoming integrated into the U.S. society and others adhering almost completely to their culture. It is likely that educational level, family structure, enclave residence may contribute to the acculturation strategy adopted by African immigrants. In this study, females were overrepresented in the Traditionalist strategy group. Notably, findings about the sex-specific nature of acculturation are inconsistent, with some studies reporting significantly higher acculturation to the host culture in males in comparison to females [59,60] In terms of differences in CVD risk, we observed that *Integrationists* had a lower adjusted odds of having elevated CVD risk than *Traditionalists.* This finding could be explained the higher rate of employment and higher incomes observed in

Integrationists who identified equally with the American and African culture. Other unmeasured confounding factors including health beliefs, health care utilization, self-care behaviors may have accounted for difference in CVD risk and hypertension control between Integrationists and Traditionalists.

STRENGTHS AND LIMITATIONS

There are limitations to this study that are worth noting. First and foremost, this was a cross-sectional study with a relatively small sample size; hence subgroup analyses contributed to a smaller sample size, thus limiting power to detect differences among groups, especially with respect to CVD risk factors. Also, due to the cross-sectional nature of the study, no causal relationships or temporal trends could be established. Since participants were recruited from churches in the Baltimore, Washington. D.C metropolitan area, they may not be representative of all African immigrants in the United States. It is possible that participants may have for instance underreported smoking behavior due to social desirability and health behaviors of church attendants may differ from non-attendants and may affect the generalizability of our results. Since this study was not a longitudinal study with hard endpoints, we were unable to determine whether the PARS10 had adequate discrimination.

To our knowledge, this was the first study to examine the association between CVD risk factors/poor health behavior and elevated CVD risk in African immigrants. We have contributed to the literature on the association between acculturation and health by focusing on an understudied immigrant population and examining contextual factors that may contribute to the acculturation process and CVD risk. This is also the first study

to use the WHO STEPS instrument in an underserved population in the US. Using the WHO STEPS protocol will also enhance the comparability of findings to West Africans residing in Africa and other countries by measuring the risk factor burden uniformly and rigorously using a WHO-recommended protocol.

RESEARCH, PRACTICE AND POLICY IMPLICATIONS

Research

The aggregation of African-descent populations into the "Black/African-American" racial category, without considering socioeconomic and cultural differences may lead to erroneous conclusions and needs re-evaluation. Researchers examining CVD disparities should purposefully recruit a diverse sample of African-descent populations in the US, including African immigrants. This study has shown that African immigrants can be engaged successfully in research. A high burden of modifiable CVD risk factors and poor health behaviors was observed. Meaningful associations were also found between CVD risk and social support, employment and health insurance with sex as an effect-modifier. Larger cross-sectional epidemiological studies are needed to confirm the findings observed in this study. Longitudinal studies are also needed to determine the evolution of CVD risk and the effect of changes in social, economic, environmental and cultural factors on the CVD risk of African immigrants in the US. As conceptualized in the modified PRECEDE-PROCEED model, genetic factors play an integral role in the acquisition of CVD. However, this component was not examined in this study. Genetic predisposition and genetic priming may contribute to CVD disparities in this population so future studies should examine genetic risk factors and their interaction with CVD risk factors.

We also observed that acculturation was significantly associated with CVD risk. However, the two measures of acculturation yielded paradoxical findings. Using the proxy measure of length of the residence in the U.S, we observed that increasing years of U.S residence was significantly associated with having ≥3 CVD risk factors/poor health behaviors and Pooled ASVD risk score ≥7.5 %. When we used the bidimensional modified Psychological Acculturation Scale as a measure of acculturation, Integrationists, (who had lived in the US longer than Traditionalists), had a 0.46(95% CI: 0.24-0.87) lower odds of having ≥3 CVD risk factors/poor health behaviors and 0.38(95% CI: 0.18-0.78) lower odds of having a Pooled ASVD risk score ≥7.5% than *Traditionalists.* This paradoxical finding suggests that the use of length of U.S residence as a proxy measure for acculturation does not directly measure elements of acculturative change (such as attitudes or behaviors) the information provided may be of limited usefulness. The modified Psychological Acculturation Scale which showed high internal consistency allowed us to orthogonally examine values, beliefs, attitudes, behaviors and cultural identity in the American and West-African dimensions.

The majority of acculturation studies in the U.S have limited to Hispanic or Asian immigrants with very little known about the process of acculturation in African immigrants. Health researchers should building on the findings in this study and examine acculturation in African immigrants to gain a better understanding of how acculturative changes influence risk for CVD. The mediating or moderating effect of acculturation on the relationship between health determinants and CVD outcomes in African immigrants should be examined. Also, although the modified Psychological Acculturation Scale which was derived from a Hispanic population showed high internal consistency in this

study, there are gaps in the literature on acculturation scales that measure multidimensional changes in health behavior (including dietary acculturation and physical activity acculturation, use of healthcare services). Developing and validating a health behavior acculturation scale in a multi-ethnic sample will inform interventions that are tailored to preventing CVD in new immigrants.

Although CVD knowledge was assessed in this study, additional research is needed to assess health beliefs, barriers (including medications, dietary and physical activity), and perceptions as they may impede the CVD prevention strategies among African immigrants.

Practice

Healthcare providers should be aware of the growing presence of African immigrants in the US as well as their unique history, background and health care needs. This study revealed a high prevalence of CVD risk factors and poor health behaviors in African immigrants with meaningful associations between social support, health insurance, employment, acculturation and CVD risk factors and poor health behaviors. Since many African immigrants migrate from low resource settings, their interactions with the healthcare system may have been limited to acute illnesses such as Malaria. They may have very little exposure to CVD prevention practices such as hypertension and cholesterol screening prior to migration. Hence, they may be less likely to engage in CVD prevention practices especially in a new and unfamiliar environment. Screenings for CVD risk in African should begin upon migration to identify individuals at high risk for CVD and intervene accordingly.

African immigrants may have difficulty adapting to the U.S. health care system and their health beliefs may be at odds with the biomedical model of disease. For instance, in a study of attitudes about hypertension among Dutch-Ghanaians, hypertension was interpreted as part of the stress of migration and that obesity was seldom perceived as a cause of hypertension. [61] It is important that health providers understand how health beliefs translates to behaviors in African immigrants - from reluctance to seek care to noncompliance to prescribed treatments. This can be achieved by assessing CVD health beliefs in the clinical setting. Health care providers should assess for social support, access to health care services and CVD knowledge acculturation in African immigrants as they may influence CVD risk factor management. Evaluating acculturation in clinical practice may be an opportunity to promote awareness, healthy behaviors, and prevention among African immigrants.

Policy

Contrasting the increasing number of African migrants in U.S., the health status and needs of these populations remain largely unexamined and this population has not been integrated into national plans and policies. In order to improve the health of African immigrants and reduce CVD risk there are policy changes that should occur. On a national level, data collection standards for instance, race and ethnicity should be reexamined by the inclusion of a diverse sample of African immigrants. For instance in the National Health Interview Survey(NHIS)and National Health and Nutrition Examination Survey(NHANES), African immigrants should be purposefully sampled from major cities such as New York, California, Texas, Maryland, Virginia, New Jersey

Washington, D.C, Minnesota where over half of African immigrants reside[9]. Data on the health of African immigrants should also be reported separately similar to Hispanic and Asian immigrants to ensure that their unique healthcare needs are better understood. Implementation of tailored intervention among African immigrants implicitly requires the identification of environmental, lifestyle and genetic factors that modify CVD risk and this will be best achieved with appropriate funding of epidemiological studies on African immigrants. It is difficult to set priorities for CVD risk reduction interventions without adequate data so funding of studies of African immigrants should be an immediate short term goal.

The ideal population for derivation of a risk prediction algorithm would be a contemporary, population-based cohort that closely reflects the general population in racial, geographic, and lifestyle/environmental factors. Given the absence of risk prediction algorithm specific to Africans, we used the Pooled ASCVD risk score which was derived from African-American and Caucasian cohorts and it is unlikely that African immigrants were represented. Ideally, the National Heart Lung and Blood Institute should emphasize the need to equally include African immigrants, African-Caribbeans and African-Americans in cohort studies that examine the CVD risk in African-descent populations.

As shown in this study, African immigrants are a vulnerable population in the US due to inadequate health insurance. There are other factors that may increase their vulnerability including socioeconomic status, immigration status, residential location and stigma. We observed a strong association between immigration status and health insurance with a significantly higher insurance rate in green-card holders/U.S citizens

than those on visas or who declined to provide that information. More opportunities should be created for immigrants to obtain healthcare regardless of immigration status to improve access to regular health care. Since the Affordable Care act was introduced during this study, it remains to be seen the impact of the legislation on health insurance rates in this population.

CONCLUSION

Overall our findings suggest that what has been described as the "healthy immigrant effect" where immigrants had less obesity, better cardiometabolic health than US-born Americans may not hold for this current generation of African immigrants. The prevalence of CVD risk factors and poor health behaviors among a relatively young group of WAI is concerning. Employment was protective against high CVD risk in females and higher social support was protective against high CVD risk in males. In females, not having health insurance was associated with higher CVD risk. Therefore, prevention strategies in this population must be tailored to the unique needs of the WAI with consideration of socioeconomic status and sex. Early intervention with medical management and lifestyle changes may prevent the worsening of CVD risk in new African immigrants. As African immigrants gain a larger presence in the U.S, it is imperative that we better understand how unhealthy acculturation may be prevented. *Integrationists* (equally identified with the American and African cultures) had lower risk for CVD and had controlled blood pressures than those who were *Traditionalists* (identified more with the African culture). Hence, ensuring the successful integration of African immigrants might reduce the risk of CVD in new African immigrants. Larger epidemiological studies are needed to confirm these findings.

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60. Ghuman PAS. Acculturation of south Asian adolescents in Australia *Br J Educ Psychol*. 2000; 2010;70(3):305 <last_page> 316. doi: 10.1348/000709900158128.

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CURRICULUM VITAE

Part I

PERSONAL DATA
Yvonne Y. Commodore-Mensah, RN, BSN

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Johns Hopkins University School of Nursing
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Baltimore, MD 21205
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EDUCATION

Year	Degree Earned	Institution	Location
2014	Doctor of Philosophy in Nursing (anticipated)	Johns Hopkins School of Nursing	Baltimore, MD
2008	Bachelor of Science in Nursing (Honors)	Fairleigh Dickinson University	Teaneck, NJ

CURRENT LICENSE AND CERTIFICATION

Year	Source	Certification #
2010	Maryland Board of Nursing	RN, R189186

PROFESSIONAL EXPERIENCE

Years	Position	Institution
2013	Research Assistant	Johns Hopkins University School of Nursing -Helene Fuld Leadership Program for the Advancement of Patient Safety & Quality
2012-2013	Project Data Manager	Johns Hopkins University School of Nursing " An Automated System for Prevention of CVD in HIV Care Settings (ASPIRE) (Dr. Jason Farley, PI)
2012	Research Assistant, Project Data Manager	Johns Hopkins University School of Nursing Hypertension Self-Care Profile Instrument Development (Dr. Haera Han, PI)

2011-2013	Graduate Research Associate	Johns Hopkins University School of Nursing, Center of Excellence for Cardiovascular Health (1P30NR011409)
2011-2012	Research Assistant	Johns Hopkins University School of Nursing, Reducing disability via a bundled psycho-social- environmental approach (Dr. Sarah Szanton, PI)
2010-2011	Research Nurse	Johns Hopkins University School of Nursing Nurse-Led Heart Failure Care Transition Intervention for African Americans (R21NR011056) (Dr. Cheryl Dennison, PI)
2008-2009	Registered Nurse	Inova Fairfax Hospital, Cardiac Telemetry Unit

HONORS AND AWARDS

Year	Award
2014	PhD Manuscript Award for Best Published Paper
2014	Winning Abstract Award(Data-based Category) Preventive Cardiovascular Nurses Association Conference , April 2014
2014	3rd Place Poster Award(Data-based Category) Preventive Cardiovascular Nurses Association Conference, April 2014
2014	A.T Mary Blades Foundation Scholarship
2013	Professional Development Award, Johns Hopkins University School of Nursing
2012	Graduate Teaching Assistant Award, Johns Hopkins University School of Nursing
2010-2012	Jonas Scholar, Jonas Center for Nursing Excellence
2008	School of Nursing Faculty Recognition Award, Fairleigh Dickinson University
2008	Sigma Theta Tau, Epsilon Rho Chapter, Fairleigh Dickinson University
2008	Phi Zeta Kappa Honor Society, Fairleigh Dickinson University
2007-2008	Campus Service Grant, Fairleigh Dickinson University
2004-2008	Fairleigh Dickinson University Honors List
2004-2008	Colonel Dickinson Academic Scholarship, Fairleigh Dickinson University

RESEARCH

Sponsored Projects

2013	Cardiovascular Disease Risk of West African Immigrants and the Effect of Acculturation, PI: Yvonne Commodore-Mensah, Sigma Theta Tau Nu Beta Chapter Award, $1000
2012	Cardiovascular Disease Risk of West African Immigrants and the Effect of Acculturation, PI: Yvonne Commodore-Mensah, Center of Excellence for Cardiovascular Health (1P30NR011409), $6000

SCHOLARSHIP

Peer Reviewed Publications

1. Shillam, C., Ho, G., Commodore-Mensah, Y. (2014) Online Biostatistics: Evidence-Based Curriculum for Master's Nursing Education. *Journal of Nursing Education*, Apr 1;53(4):229-32.
2. Dennison Himmelfarb, C.R., Commodore-Mensah, Y. Hayman, L.L. (2014) New Cardiovascular Prevention Guidelines Offer a New Approach and Effective Strategies. *Journal of Cardiovascular Nursing,* Mar-Apr;29(2):102-4.
3. Commodore-Mensah, Y., Samuel, L. J., Himmelfarb, C.R., Agyemang, C. (2014) Hypertension and Overweight/Obesity in Ghanaians and Nigerians living in West Africa and Industrialized Countries: A Systematic Review. *Journal of Hypertension,* Mar;32(3):464-72.
4. Samuel, L.J, Commodore-Mensah, Y., Himmelfarb, C.R (2013). Developing behavioral theory with the systematic integration of neighborhood social capital concepts. *Health Educ Behavior*, Oct 2, [Epub ahead of print]
5. Han, H.R, Lee, H., Commodore-Mensah, Y., Kim, M. (2013) Development and Validation of the Hypertension Self-Care Profile: A Practical Tool to Measure Hypertension Self-Care. *Journal of Cardiovascular Nursing,* May-Jun;29(3):E11-20.
6. Moscou-Jackson, G., Commodore-Mensah, Y., Farley, J., DiGiacomo, M. (2013) Smoking Cessation Interventions In People Living With HIV Infection: A Systematic Review. *Journal of the Association of Nurses in AIDS Care.* an-Feb;25(1):32-45.
7. Benita Walton-Moss, B., Samuel, L., Nguyen, T.H., Commodore-Mensah, Y., Hayat, M., Szanton, S.L. (2013) Community Based Cardiovascular Health Interventions in Vulnerable Populations: A Systematic Review. *Journal of Cardiovascular Nursing,* April 22,
8. Commodore-Mensah, Y., Dennison, C.R (2012). Patient Education Strategies for Hospitalized Cardiovascular Patients:A Systematic Review. *Journal of Cardiovascular Nursing*; 27, 2, 154-174

CONFERENCE MEETINGS/PRESENTATIONS

International

2014- Commodore-Mensah, Y. Dennison Himmelfarb, C.R. The AFRO-CardiAC study: Examining the Cardiovascular Disease Risk Profile of West African Immigrants residing in the United States, Preventive Cardiovascular Nurses Association, 2014, Atlanta, Georgia (Podium)

2014- Commodore-Mensah, Y., Himmelfarb, C.R, Mark, H., Farley, J.E., Provider Management of CVD in an Urban HIV Practice: Room for Improvement. , Preventive Cardiovascular Nurses Association, 2014, Atlanta, Georgia (Poster)

2013- Commodore-Mensah, Himmelfarb, C.R, Mark, H., Farley, J.E., Provider Prevention of CVD in an Urban HIV Practice: Room for Improvement. Association of Nurses in AID Care (ANAC) Conference; Georgia (Podium)

2013- Commodore-Mensah, Y., Himmelfarb, C.R, Mark, H., Farley, J.E., Prevalence of CVD Risk Factors among an Urban Cohort of Persons Living with HIV. Association of Nurses in AID Care (ANAC) Conference; Georgia (Poster)

2011- Nguyen, T.H., Samuel, L., Commodore-Mensah, Y., Szanton, S.L., Walton Moss, B. Community Based Cardiovascular Interventions in Vulnerable Populations: A Systematic Review. International Network for Doctoral Education in Nursing (INDEN), University of Malta, Malta. (Poster)

PROFESSIONAL ACTIVITIES

2011-2012	Vice-President Doctoral Students Organization, Johns Hopkins School of Nursing
2011-present	Member, American Heart Association (Cardiovascular Nursing Council)
2010-present	Member, Sigma Theta Tau International Nursing Honors Society, Nu Beta Chapter
2010-present	Member, Preventive Cardiovascular Nurses Association
2010-present	Member, Representatives for Equal Access to Community Healthcare (REACH) Ghana
2007-2008	Phi Zeta Kappa and Phi Omega Epsilon Honors Societies

PEER-REVIEW ACTIVITIES

2014	Invited Reviewer, British Medical Journal(BMJ Open)
2013	Invited Reviewer, European Journal of Cardiovascular Nursing
2013	Invited Reviewer , Western Journal of Nursing
2012	Co-reviewer, Journal of Cardiovascular Nursing

Part II

EDUCATIONAL ACTIVITIES

Classroom Assistance

Spring 2014, NR.110.202.8101.SP 14 Biostatistics, Teaching Assistant, 40 students (Baccalaureate Program Pre-requisite)

Fall 2013, NR.110.202.8101.FA13 Biostatistics, Teaching Assistant, 40 students (Baccalaureate Program Pre-requisite)

Spring 2013, NR.110.507.0101.SP13 Statistical Literacy and Reasoning in Nursing Research, Teaching Assistant, (Masters Program)

Spring 2012, NR.110.405.0101.SP12 Public Health Nursing, Teaching Assistant,78 students, Baccalaureate Program

Fall 2012, PH. 140.611-612, Statistical Reasoning in Public Health I-II, School of Nursing Tutor, 35 students, (Masters Program)

Fall 2011, NR110.503, Applications of Research to Practice, Teaching Assistant, 32 students (Masters Program)

New Course Development

Fall 2013, NR.110.202.8101.FA13 Biostatistics, Co-developer, (Baccalaureate Program

ACADEMIC SERVICE

2013	Invited Member, Dean of Johns Hopkins University School of Nursing Search Committee
2011-2013	Invited Member, Diversity Committee, Johns Hopkins University School of Nursing